Vol. LXXII DECEMBER, 1920 No. 6

ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

Edited by
LEWIS STEPHEN PILCHER, M.D., LL.D.
of New York

With the Collaboration of
SIR WILLIAM MACEWEN, M.D., LL.D. of Glasgow
SIR W. WATSON CHEYNE, C.B., F.R.S. of London

J. B. LIPPINCOTT COMPANY, PUBLISHERS
MONTREAL PHILADELPHIA LONDON

Entered at the Post-Office at Philadelphia and admitted for transmission through the mails at second-class rates
Price, $7.50 a year.

ANNALS of SURGERY

VOL. LXXII DECEMBER, 1920 No. 6.

MULTIPLE POLYPOSIS OF THE INTESTINAL TRACT

BY JOHN EDMUND STRUTHERS, M.D.

OF ROCHESTER, MINN.

SCHOLAR IN SURGERY, MAYO FOUNDATION

FROM a clinical point of view intestinal polyposis is considered a comparatively rare disease occurring in young and middle-aged persons. Excrescences and polypoid projections of the mucosa in various parts of the alimentary tract are nevertheless frequently found at necropsy. The association of the excrescences or polypoid growths with inflammation of the intestines, or at least with a clinical history of dysentery, is quite common.

The earliest case reported in the literature was probably that of Menzel, in 1721, whose patient was a boy aged fifteen, with dysentery. At post-mortem it was observed that the mucous membrane of the large intestines had great numbers of wart-like excrescences. There is no further mention of the condition until 1832, when Wagner, in describing the end-results of ulceration of the colon, stated that "sometimes on the margins of scars and on the smooth cicatrices of healed ulcers, tiny polypoid excrescences were found." In 1839 Rokitansky confirmed Wagner's findings and added, "These small excrescences had their origin from islands of the mucous membrane that remained after the ulcerative process had ceased." In 1861 Lebert reported the case of a woman, aged thirty-two years, who had suffered from obstinate diarrhœa for years. At necropsy, examination of the mucous membrane of the colon showed hundreds of little polypi varying in size from 0.5 by 0.5 cm. to 0.5 by 1.5 cm.; some of these were pedunculated, others sessile. Lebert's account contains the first description of the polypi themselves. They are described as consisting of fibrous tissue containing ramifying blood-vessels but no glands. Glandular tubules, however, surrounded the base of the polypi. The same year, 1861, Luschka described his findings in a case in which the polypi covered the mucous membrane from the ileocæcal valve to the anus. These polypi were found to consist of glands resembling the glands of Lieberkühn, except that they were longer, many of them more or less branched, and some of them dilated into cyst-like spaces.

Virchow, about this time, gave the microscopic findings on the case of a boy, aged fifteen, who had dysentery. The polypi were vesicular, fluctuating prominences, and many of them had scattered over their surfaces small openings from which gelatinous material protruded and could be expressed. Under the microscope these vesicles were found to be

dilated crypts of the glands of Lieberkühn filled with a mucous material. This case and the cases of Lebert and Luschka, Virchow called colitis polyposa cystica. Woodward, in 1861, reported a case similar to that of Lebert. All these early cases were associated with dysentery. Collier reported a case of multiple polypi of the stomach and intestine similar to the case of Carroll.

In 1907 Doering reported fifty-two cases; fifty he had collected from the literature; two were his own. In 1916 Soper collected eight additional cases from the literature and reported one of his own. Seven of these last nine patients were operated on, three of whom died. Doering observed from his collected cases that the greatest number of cancers developed in the cases of polyposis which occurred in early adult life; namely, between the ages of fifteen and thirty-five years. The distribution of the cases was as follows:

Between 15 and 25 years	7 cases
Between 25 and 35 years	7 cases
After 35 years	3 cases
Information lacking	6 cases

Doering also observed that intestinal polyposis occurred twice as frequently in males as in females.

On the basis of the facts presented in the sixty-one cases reviewed by Doering and Soper, the following is apparent:

1. Polypi are most frequent in children and in young adults.
2. Twenty-six (43 per cent.) showed the presence of adenocarcinoma.
3. The most frequent sites of the lesion are the rectum, sigmoid, and the splenic flexure.
4. The small intestine seems to be involved rarely; the ileum in five cases, the jejunum and duodenum each in four.
5. The polypi tend to occur in members of the same family.[9]

Ten other cases of intestinal polyposis are reported in the literature. Bratrud, Watson, Norbury, Edwards, Drummond, Furnivall, Newbolt and John B. Murphy each reported one case. Hewitt and Howard report two cases. In this series there were seven males and three females. One case occurred in a child of thirteen years. The predominating symptoms were bleeding from the rectum in three cases, blood-tinged stools in three cases, prolapse associated with bleeding in two cases, and obstinate constipation in one case. All the cases were treated surgically: cauterization with forceps removal of some of the polypi in four cases, in the remaining cases colotomy, colostomy, colectomy, appendicostomy, resection of the rectum, and end-to-end anastomosis were performed.

From röntgen and operative findings it was learned that the rectum and sigmoid were involved in eight cases; the rectum and transverse colon in one; advanced carcinoma of the sigmoid with multiple polypi above and below the growth in one.

In reporting these cases five were designated as polypi; four as adenomas; and one as an adenomatous polypus. Pathologic reports on the case of carcinoma of the sigmoid and one of the other cases showed them to be papillary and tubular columnar-cell carcinoma.

Three of the ten patients are reported to have completely recovered, in two of these cauterization was done, two were reported as markedly improved; two died, and the condition of three has not been ascertained. The length of time after operation when these reports were obtained was not specified. The mortality with three cases unaccounted for is 20 per cent.

With an increasing number of cases of polypi reported in the literature there was apparent confusion in the differentiation of adenoma and the polyp type of growth. Hauser uses the term "polyposis intestinalis." Verse simply admits the difficulty of discrimination. Adami speaks of polypoid tumors of the intestinal tract which have the general structure of adenoma. Hertzler refers to intestinal polyposis as hyperplasia of the mucous membrane; Kaufmann speaks of adenomas, both polypoid and papillary. Kassemeyer reported 224 cases of intussusception caused by tumors, of which 116 were benign; 73 of these benign growths were polypi and adenomas. Watts, Hartmann, and Karajan all reported cases in which operations had been done several times for intussusception caused by polypoid adenomas and polypoid tumors. Hewitt and Howard liken their first case to that of Rokitansky and their second to that of Luschka, considering the second case but an advanced stage of the first.

The series of thirty-nine cases in this study were observed in the Mayo Clinic from January, 1911, to February, 1920. Carroll's case, which was reported by Soper, is also included, since it came within this period.

AGE AND SEX OF PATIENTS

19 to 30 years	15
31 to 40 years	9
41 to 50 years	7
51 to 60 years	5
61 to 68 years	3
Males	29
Females	10

DURATION OF SYMPTOMS

Less than 1 year	4
1 to 2 years	9
3 to 4 years	4
5 to 6 years	11
7 to 34 years	11

Shortest period of symptoms 3 weeks; longest 34 years.

TYPE OF ONSET

Mild diarrhœa followed by pus and blood	8
General abdominal distress	8
1 marked nausea and vomiting	
1 marked constipation	

1 food relief (duodenal ulcer)	
Sudden onset, diarrhœa, pus and blood	6
1 of these alternated with constipation	
Constipation	3
Pain in left lower quadrant	3
Constipation marked in 1 of these	
Bleeding from the rectum	3
Marked abdominal colics with sudden diarrhœa	2
Rectal pain with diarrhœa	2
Bleeding with hemorrhoids	2
Mild symptomless diarrhœa	2

With the exception of five patients, all had periods of diarrhœa[18] later; these included two patients with constipation, two with abdominal distress, and one with diagnosis of duodenal ulcer.

Constipation, although the chief complaint on admission in but one case, was marked in one patient with general abdominal pain, in one with marked rectal pain, and in the patient with frequency of urination who was in a uræmic condition when he entered the Clinic. His case may belong to the group of cases discussed by Preble. At some time during the course of the disease thirty-one of the thirty-nine patients had abdominal pain, eight only giving a negative history. The patient with the ribbon-like stools had carcinoma of the sigmoid with multiple polypi below the growth.

Fifteen of the patients had some rectal complaint, although it was an early symptom in but eight. Four complained of absolute inability to control the bowels, the others of bleeding from the rectum, in two instances marked; the degree of bleeding in the other patients was variable.

In the more severe cases in which the colon and rectum were extensively involved by polyposis, the onset of the disease was gradual, with but few exceptions becoming progressively worse over a period of many years. The exceptions were the cases in which there was a history of diarrhœa of less than five years.

COMPLAINT ON ADMISSION TO THE CLINIC

Diarrhœa with pus and blood	17
General abdominal distress	5
Abdominal pain with nausea and vomiting	3
Hemorrhoids	3
Mild diarrhœa	3
Bleeding from the rectum	3
Rectal pain	2
Passage of ribbon-like stools, constipation slight	1
Constipation	1
Frequency of urination	1

LOSS OF WEIGHT

The loss of weight varied markedly with the severity of the disease. In two cases patients with a mild constant diarrhœa gained weight, each less than ten pounds.

Patients losing less than 10 pounds	6
Patients whose weight fluctuated slightly	8
Patients losing from 15 to 30 pounds	8
Patients losing from 30 to 45 pounds	8
Patients losing from 45 to 60 pounds	5
Patients losing 60 pounds or more	2

BLOOD

The duration of the disease and the degree of bleeding has a marked effect on the degree of anæmia. The blood counts were made in twenty-nine patients; the eosinophile count in six cases showed an eosinophilia in one (7.3 per cent.). The lowest erythrocyte count was 2,700,000; the lowest leucocyte count was 4800; the highest leucocyte count was 17,000.

Hæmoglobin between 90 and 80	5
Hæmoglobin between 79 and 70	7
Hæmoglobin between 69 and 60	9
Hæmoglobin between 59 and 50	1
Hæmoglobin between 49 and 40	4
Hæmoglobin between 39 and 30	3

EXAMINATION OF STOOLS

Stool examinations were made in twenty-seven cases:

Stools reported negative for parasites, but containing pus and blood	12
Stools reported negative for parasites, pus and blood	7
Nonmotile amœba with trichomonades	3
Endamœba histolytica	2
Trichomonades	2
Cercomonades	1

PROCTOSCOPIC EXAMINATION

Multiple polyposis of the rectum and sigmoid	19
Chronic ulcerative colitis with multiple polypi	4
Probable carcinoma of the sigmoid with multiple polypi, all below the growth	3
Granular polyposis	2

Thirty cases were diagnosed multiple polyposis. In twenty-eight there were positive proctoscopic findings, two by means of the X-ray, one a case of gastric polyposis, and one a case of multiple polypi of the descending colon with filling defect. In three of the remaining cases a probable clinical diagnosis of multiple polypi was made.

Nineteen specimens were removed at proctoscopic examination; in two instances a second specimen. The primary diagnosis in each was carcinoma and the secondary was negative for carcinoma. The second specimens, however, were not from the same site. One of the patients came to operation and the specimen removed at operation was reported a polypus. Reports on specimens removed were:

Polypi—negative for carcinoma	8
Adenoma	6
Carcinoma	2

Inflammatory tissue	1
Papilloma	1
Mucous polypus	1
	19

OPERATIONS

Twenty-two of the thirty-nine patients came to operation.

The Brown was the primary operation in ten cases. In one other case it was secondary to a colostomy performed elsewhere; in two cases it was followed by an ileocolostomy; in two by a colectomy; in two by an ileosigmoidostomy; and in four there was no second-stage operation. There were four primary ileocolostomies; two colectomies with the exception of twelve inches of the sigmoid and rectum; one was a permanent ileostomy; one was a complete colectomy with removal of five inches of the lower ileum, and permanent ileostomy; one was a Mikulicz first- and second-stage operation; one was a Kraske, secondary to a colostomy; one was an appendicostomy; one was a Desquin-Mixter midline cautery operation, and one was a partial resection of the stomach and removal of three-fifths of the pylorus. This patient was rerayed one year later; the remaining portion of the stomach was still covered with polypi.

EXTENT OF INVOLVEMENT AT THE TIME OF OPERATION

Rectum only	2
Rectum and sigmoid	3
Rectum and transverse colon	1
Rectum, sigmoid, and descending colon	2
Rectum, sigmoid, descending and transverse colon	1
Rectum to the ileocæcal valve	5
Rectum to the ileocæcal valve, with carcinoma at the splenic flexure and sigmoid	1
Ileocæcal valve only	1
Ileocæcal valve extending into the transverse colon	1
Ileocæcal valve extending into the descending colon	1
Ileocæcal valve, hepatic flexure marked, colon slight involvement	2
Stomach and jejunum	1
Stomach	1

REPORTS ON SPECIMENS REMOVED AT OPERATION

Polypi	9
Papillomas	3
Carcinomas	2
Adenocarcinomas	2
Colitis	1
Inflammatory tissue	1

Both cases of adenocarcinoma (Figs. 1 and 2) were in specimens from the rectum. In one of these cases the colon was found to be covered with polypi. In each instance of carcinoma of the sigmoid the polypi were below the growth.

There were two cases of duodenal ulcer and one of gastric ulcer.

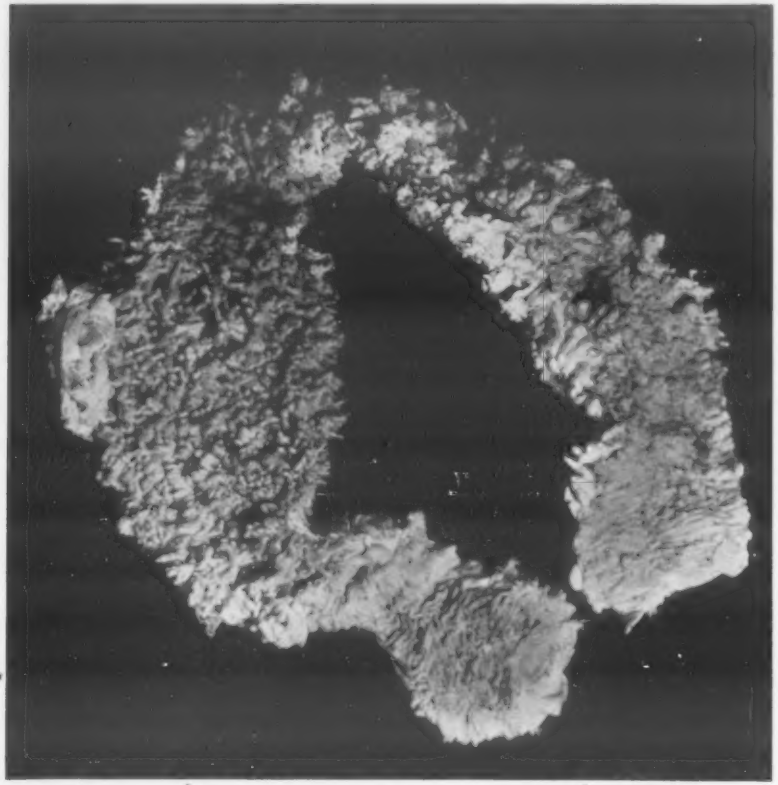


FIG. 1 (112677).—Section of ileum, cæcum, ascending transverse and descending colon and sigmoid showing extensive polyposis.

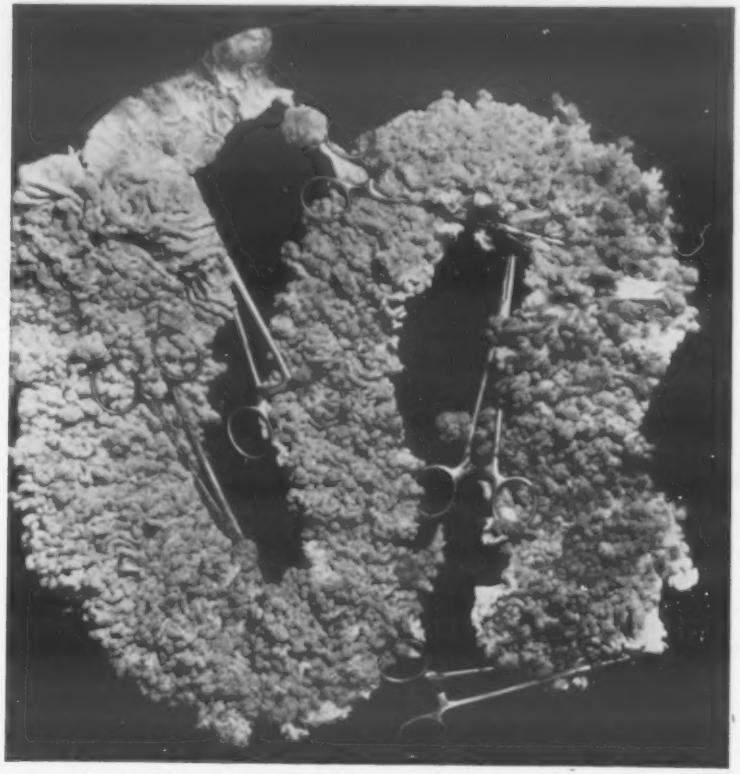
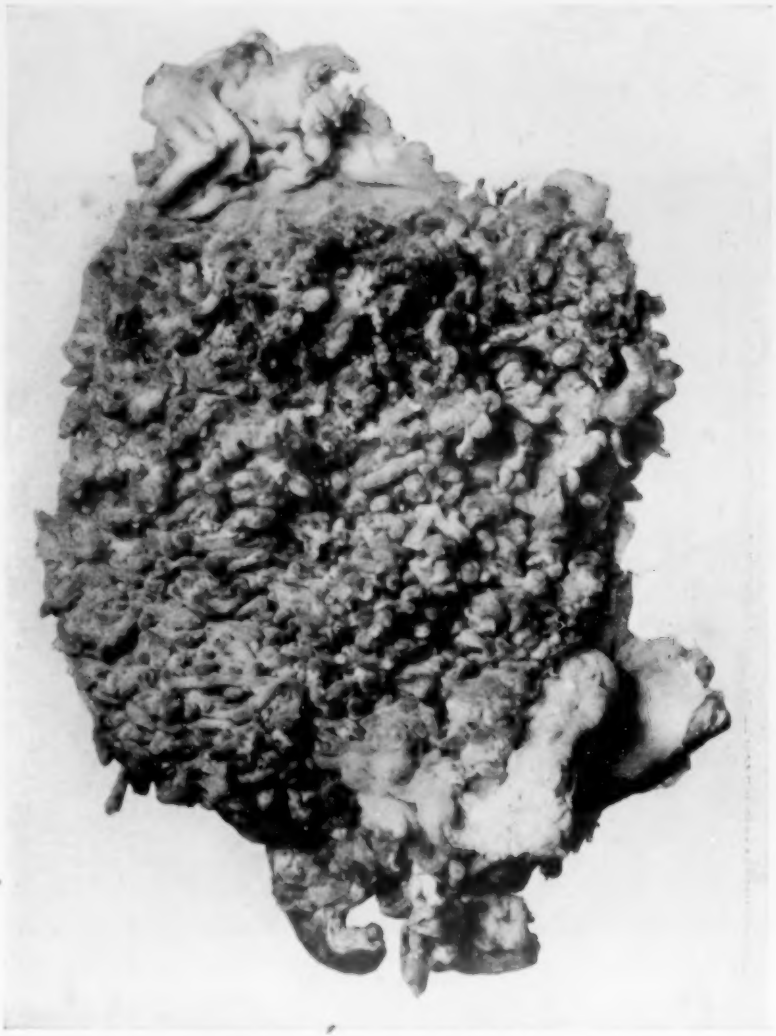


FIG. 2 (301683).—Polyposis throughout the colon. Numerous pedunculated polypi (largest 2.5 cm.)



FIGS. 3 AND 4 (114349).—Section of cæcum and ascending colon showing multiple papilloma.

One case of duodenal ulcer was associated with amœbic dysentery and with a history of extensive gastric trouble; the diagnosis was confirmed by X-ray. The other duodenal ulcer and the gastric ulcer were found at operation.

RÖNTGEN EXAMINATION

Thirteen patients in the series were not rayed.

Chronic ulcerative colitis	10
Lesion of the rectosigmoid	5
Lesion of the right half of the transverse colon and hepatic flexure	2
Gastric polyposis	1
Multiple polypi of the descending colon with filling defect	1
Duodenal ulcer	1
Intestinal stasis with obstruction	1
Colon negative	5

Questionnaires were sent to all the patients with the exception of those who were operated on or those sent home under medical treatment, or those who had been in correspondence with the Clinic within a period of four months previous to the compilation of these statistics. Replies were received to the questionnaires from all but four.

POST-OPERATIVE DATA

Eight patients reported a decided improvement in their general health; one reported slight improvement; one made no statement as to health or general condition. Reports of death were received in two cases; diagnosis of carcinoma had been made in both of these cases and confirmed at operation. In one instance the patient died ten weeks after leaving the Clinic and came to necropsy. A report of a general carcinomatosis with metastasis to the liver was returned. The date of death of the second patient was not stated. The mortality in this group was 16.66 per cent. (Tables I and II).

Nineteen of the twenty-two cases of intestinal polyposis treated surgically are accounted for, with a mortality of nine (47.34 per cent.). If, however, Case 167383 is eliminated, the mortality falls to 42.08 per cent.

DATA CONCERNING PATIENTS NOT OPERATED ON

Questionnaires were sent to fourteen medical patients and replies were received from twelve. Four reported that they were so markedly improved that they consider themselves well; three simply reported they are improved; one is unimproved and one is growing progressively weaker. The latter was a patient with advanced nephritis and the polypi were found in our routine examination. Three patients were reported to have died, ten weeks, two years, and four years, respectively, after leaving the Clinic. The diagnosis in the case of the patient who died ten weeks after leaving the clinic was chronic ulcerative colitis of the descending and transverse colon and sigmoid with multiple polypi of the rectum. The second patient came to necropsy and the cause of death was given as

TABLE I

MULTIPLE POLYPOSIS OF THE INTESTINAL TRACT

Immediate Surgical Mortality

Date of registration	Case	Diagnosis	Operation	Date of death
Jan. 27, 1913	96200	Chronic ulcerative colitis with papillomatous colon	January 27, 1913, Brown operation;* appendectomy; July 4, 1914, ileocolostomy	August 22, 1914.
Sept. 2, 1914	114349	Chronic inflammatory mass in right lower abdomen	Resection 6 inches of ileum, all of cæcum, ascending colon, one-half transverse colon; appendix involved in resection; July 12, 1915, resection of remaining one-half transverse colon, all of descending colon and sigmoid	July 27, 1915.
July 25, 1916	167383†	Papillomatous growths in rectum	July 25, 1916, transfusion	August 5, 1916.
June 11, 1917	196935	Chronic ulcerative colitis with multiple polypoid growths	June 23, 1917, Brown, first stage; June 25, 1917, second stage, Brown operation	June 27, 1917.
Aug. 30, 1917	206607	Chronic ulcerative colitis with multiple polypoid growths	September 12, 1917, Brown operation	September 16, 1917.
Nov. 14, 1919	296662	Chronic ulcerative colitis	November 25, 1919, Brown (permanent ileostomy). Resection of cæcum and ileocæcal valve. Appendectomy	December 23, 1919.
Jan. 6, 1920	301683	Polyposis of rectum and sigmoid	January 24, 1920, complete colectomy with removal of 5 inches of lower ileum. Permanent ileostomy	January 26, 1920.

* The Brown operation consists of an ileostomy about 6 inches above the ileocecal valve and bringing both ends through the incision, the distal end above.
† This patient was brought to the Clinic on a stretcher, markedly emaciated, hæmoglobin 37 per cent., and died the sixteenth day.

TABLE II

MULTIPLE POLYPOSIS OF THE INTESTINAL TRACT

Surgical Cases

Date of registration	Case	Diagnosis	Operation	Data obtained from inquiries sent Feb. 2, 1920
Jan. 23, 1914	99488	Intestinal stasis with obstruction	Resection of 10 inches of ileum, appendix, cecum, ascending colon and hepatic flexure and two-thirds of transverse colon	Marked improvement in general condition.
Aug. 12, 1914	112677	August 12, 1914, polypoid colitis; November 30, 1918, chronic ulcerative colitis	August 12, 1914, Brown operation * and appendectomy. January 5, 1915, complete colectomy except 12 inches of the sigmoid	Back to normal weight, feels stronger but tires easily.
May 28, 1915	131844	Chronic ulcerative colitis. Endamœba histolytica	Ileocolostomy	Improving steadily, gaining in weight and strength.
Mar. 24, 1916	155603	Chronic ulcerative colitis and proctitis with multiple polyps	Complete ileostomy and appendectomy	Marked improvement. February 5, 1920, came to the Clinic because of prolapse of the intestines. Repaired ileostomy incision. To return later.
April 10, 1916	157034	Multiple carcinoma of small and large bowel, and upper rectum	Appendicostomy	Died—date not given.
Feb. 2, 1917	184810	Granular sigmoiditis and proctitis with multiple polypi of the sigmoid	February 20, 1917, Brown operation and appendectomy. October 23, 1918, ileosigmoidostomy	Marked improvement in general health.
Jan. 30, 1918	220600	Duodenal ulcer; colitis. Endamœba histolytica	Posterior gastro-enterostomy. Three pedicled, small growths extending from jejunum into the ileum. Stomach covered with small growths	Health excellent. Gained in weight. Portion of small intestine removed elsewhere in March, 1919. Total weight gained 40 pounds.
Nov. 8, 1918	250518	Gastric polyposis	Three-fifths of stomach and pylorus removed. Polypa operation	No gain in weight or strength. General health slightly improved.
Feb. 22, 1919	196306	Multiple polyposis of the colon	Brown operation	Excellent.
Aug. 4, 1919	282550	Chronic ulcerative colitis with multiple polyposis	First stage Brown operation	Improvement marked, though still has some ulceration in rectum.
Oct. 6, 1919	292082	Multiple polyposis of colon; filling defect transverse colon	Exploration. Extensive masses in every part of transverse colon. Diagnosis, adenocarcinoma	Died January 16, 1920. Necropsy: General carcinomatosis. Marked involvement of liver.

* The Brown operation consists of an ileostomy about 6 inches above the ileocæcal valve and bringing both ends out through the incision—the distal end above.

primary carcinoma of the lower bowel with metastasis to the liver. Carcinoma had been diagnosed at the clinic. The cause of death in the third case was not stated. The mortality in this group with two patients unaccounted for was 25 per cent. (Table III).

Two of the four patients who did not reply to questionnaires were medical and two were surgical cases. One of the latter wrote that he was coming to the clinic, giving no information as to his general condition. This patient had carcinoma of the hepatic flexure and transverse colon with multiple polypi of the rectum. In 1917 he was operated on and eight inches of the ileum, together with the cæcum, ascending colon, and more than half of the transverse colon were removed, and an end-to-end anastomosis made with a Murphy button. In February, 1919, he returned to the clinic with a fecal fistula and obstruction just below the point where the ileocolostomy had been performed. There was an extensive recurrence of the polypoid growths in the transverse colon. It was thought that a Brown operation would be the best, in order to rest the colon, but no arrangement for this having been made with the patient an ileosigmoidostomy opening was made in the ileum eight inches above the point of the previous anastomosis with the transverse colon. In the second surgical case there was an extensive carcinoma of the sigmoid and rectum with multiple polypi below the growth. In the two medical cases there was extensive polyposis of the rectum as far as could be seen with a 14-inch proctoscope.

In the two groups of patients to whom questionnaires were sent there is a known mortality of two and three, respectively (20.83 per cent.). Adding to this the immediate surgical mortality of seven, and the death of one medical patient who committed suicide because of unimproved condition, the total mortality in the thirty-five cases is thirteen (37.14 per cent.).

The average age of the patients treated medically was thirty-nine years and ten months; of those treated surgically thirty-six years and six months. The average duration of symptoms in the former group was five years and eight months; in the latter, seven years. If, however, Case 167383, in which transfusion was done, is omitted, this period immediately jumps to seven years and six months. In comparing the patients age for age, the prognosis was no more favorable in the younger than in the older patients. The best prognosis can be given in those cases in which the growths are localized and can be removed surgically.

In comparing these two groups of statistics it should be remembered that the patient who came to operation had no possible chance of recovery from medical treatment, and that surgery offered him the only chance for life.

Nervous symptoms in this series were not significant enough to report.

The findings in the operative cases and in the cases that came to necropsy indicated that multiple polyposis is a diffuse condition of the

TABLE III

MULTIPLE POLYPOSIS OF THE INTESTINAL TRACT

Medical Cases

Date of registration	Case	Diagnosis	Condition of bowels, diarrhœa, pus, blood	Rectal pain	Abdominal pain	General health, weight and strength
July 11, 1910	40142	Multiple polyposis of rectum, sigmoid and colon. Diagnosis of carcinoma made at Clinic	Progressively worse until death	.....	.....	Died January 25, 1914, post-mortem showed general carcinomatosis with marked metastasis to liver.
Jan. 25, 1912	63425	Papillomas of large bowel. Malignant	Constant passage of pus and blood with diarrhœa	Slight with stools	General; localized at sigmoid	Progressively worse the last six months. Died 1916.
Mar. 14, 1912	65403	March 12, 1914, amœbic dysentery. August 17, 1914, chronic ulcerative colitis with multiple polyposis. January 10, 1918, multiple polyposis	Unchanged, 10 to 12 stools daily with pus and blood	Occasional but not severe	Slight general distress, not so severe as formerly	General health much improved, gained in weight and strength.
Feb. 18, 1914	100828	Papillomas of rectum and bowel	No diarrhœa now, occasional pus and blood	No longer present	None	Gained after leaving Clinic. Operation 1918. Type of operation not given; health good.
Sept. 5, 1914	114579	Multiple polypi of rectum and colon	No diarrhœa now, occasional blood	None	None	Much stronger and does all kinds of work.
Sept. 6, 1915	140421	Chronic diffuse papillomas with colitis	Unimproved	None	None	Strength good; lost 15 pounds in weight.
June 15, 1916	162733	Multiple polypi of rectum	No diarrhœa now, occasional blood	.....	Cramps entirely gone	Weight and strength remain the same.
Jan. 15, 1917	183218	Multiple polypi of rectum and colon	Periodically, attacks less frequent	.....	Some slight general pain across lower abdomen with diarrhœa	Generally better. Weight same. Strength varies, always regained.
May 7, 1917	193244	Chronic ulcerative colitis with multiple polypi	Fullness of rectum persists. Some constipation	When cold?	Never had abdominal pain	Lost some weight and strength until past year; now stationary.
April 30, 1918	229689	Papillomas of bowel	No diarrhœa now	Dull rectal pain at times, though not severe	Occasional, not sufficient to trouble patient	Weight and strength normal.
April 11, 1919	267096	April 11, 1919, chronic ulcerative colitis of descending colon and sigmoid. February 3, 1920 same plus transverse colon. Multiple polyps	Slight improvement. Pus and blood present. General condition worse	Some dull rectal pain with stool and when tired	Never had abdominal pain	Died February 7, 1920
Oct. 4, 1919	293087	Chronic nephritis with uremia. Multiple polypi of rectum	Constipation unchanged	Slight with stool	.....	Very weak; some weight loss.

colon. The findings of Hewitt and Howard, that the polypi in the rectum are situated along the side of the intestinal wall, while higher up in the colon they are situated along the line of attachment of the mesentery, have not been confirmed in the Mayo Clinic (Figs. 3 and 4). Hewitt and Howard concluded that the islands and tags of mucosa and submucosa that had been the source of polypus formation appeared to depend for their preservation on the arrangement of the blood supply. Polypi situated in these particular areas, because of the increased blood supply, could better withstand any destructive action, and necrosis would not take place. At the same time, however, it would produce active hyperplasia of the mucous glands and the submucous connective tissue and permit these particular polypi to thrive better.

One patient only had a positive Wassermann, a second a suspicious Wassermann which was to be repeated later, but the patient did not remain for complete examination (Figs. 5 and 6). There was one case of lues latens.

Nine patients gave a family history of tuberculosis, but only five of these were in the immediate family. Two gave a family history of cancer; one of these patients had a carcinoma of the rectum removed one year before coming to the clinic.

POSSIBLE ETIOLOGY AND PATHOLOGY

Schwab has advanced the theory that constipation is the cause of polyposis and that polyposis usually develops first in the rectum and then ascends the gastro-intestinal tract. This theory is hardly tenable if the prevalence of polyposis in males and of constipation in females has any significance. According to the statistics of Doering, twenty-five cases of polyposis occurred in males and seventeen in females; in nine of the cases the sex was not given. Newbolt reported thirty-seven cases, twenty-three (67.6 per cent.) of which occurred in males, fourteen (32.4 per cent.) in females. In the present series of thirty-nine cases, twenty-nine (74.3 per cent.) were in males, ten (25.7 per cent.) in females. Of the ten cases collected in the literature by me, other than those reported by Soper, seven (70.0 per cent.) occurred in males and three (30.00 per cent.) in females. Although constipation may have some bearing on the etiology of polyposis, it cannot be considered the principal etiologic factor. Rokitansky, on the other hand, believed that intestinal polypi arise from the margins of dysenteric ulcers. According to the proctoscopic examination of patients and the microscopic examination of specimens removed at operation in cases observed in the Clinic, the frequency of ulceration associated with the frequency of polyposis tends to confirm this theory. In the present series there were eleven cases of chronic ulcerative colitis and eight cases of intestinal infections. Meyer considers the entire epithelial process secondary and states that polypus formation can only be explained through a congenital malformation of

FIG. 5 (199399).—Section showing extensive polyposis at hepatic flexure, ulceration at proximal end of growth (6 by 7 cm.).

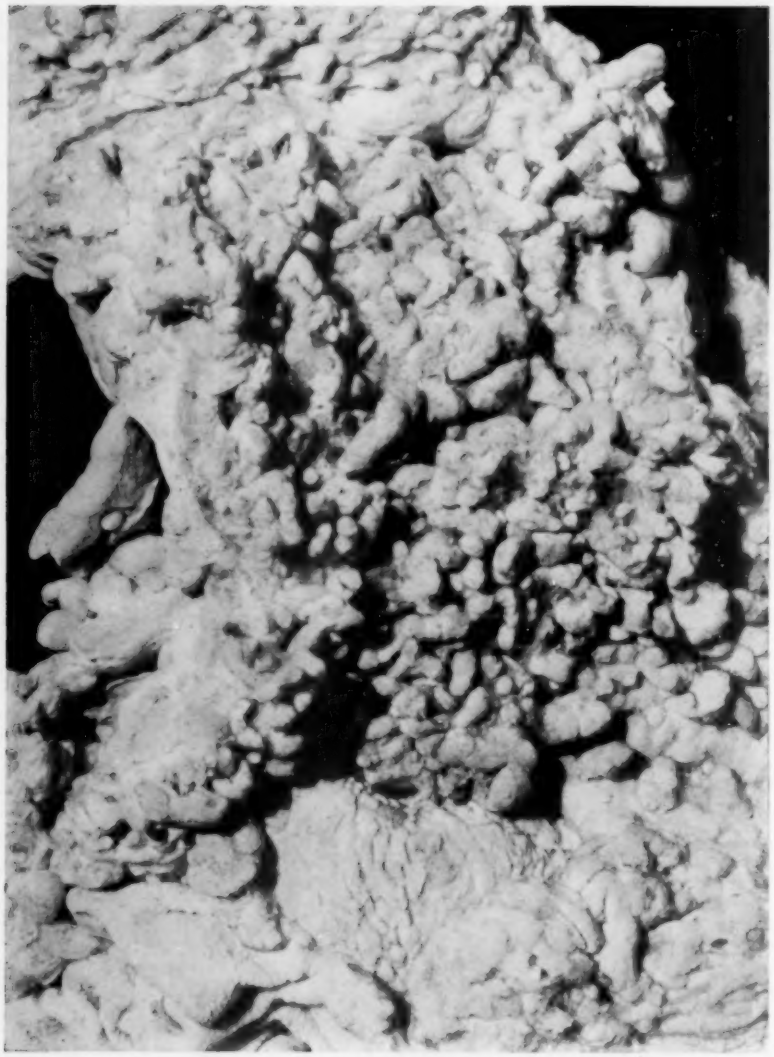


FIG. 6 (199399).—Section showing extensive polyposis at hepatic flexure, ulceration at proximal end of growth (6 by 7 cm.).

the tissue of the intestinal wall, which is primary and extends into the mucosa and submucosa. Lebert claims that a chronic irritation is the causative agent.

For the sake of convenience tumors of the intestinal tract may be divided into three groups. The papillomas are those tumors in which the surface epithelium, either cutaneous or mucous, is involved; they are usually found low down at the mucocutaneous margins. Polypi result from hypertrophy of the mucous membrane, or originate as true tumors. The adenomas form the group in which the neoplasms are derived from pre-existing glands or glandular remnants. Apparently early in this disease, in a large percentage of cases, there is a general colitis which, as it progresses, forms a number of undermining ulcers. These tend to increase in number, to fuse, and to increase in size until large areas of the colon are involved. This ulcerative process, although severe and chronic, is such that portions of the mucosa and submucosa adjacent to, and supplied by, primary arterial branches are preserved. It is these preserved portions that were seen studding the surface of the colon. As healing takes place, under favorable conditions, the irregular margins of these elevations are smoothed off and remain as rounded sessile or polypoid projections from the mucous membrane. This is the so-called multiple polyposis or colitis polyposis. As in all healing processes the proliferated fibroblasts begin to contract with resultant cicatrization, a natural result could be the occlusion of the tubules in the polypi. So long as the secreting cells in the walls of the polypi functionate they increase in size with the formation of retention cysts. Several tubules thus occluded in polypi will cause them to appear as a collection of cysts. Thus this condition, which is probably but an advanced stage of colitis polyposis, is what Virchow designated as colitis polyposis cystica.

The elevation of the thickened and altered mucosa results in increased friction and traction, which in turn stretch the surrounding adjacent mucosa and cause the formation of a pedicle. Further changes may in turn result in fibrosis and severe inflammatory conditions, the final and most important of which is carcinomatosis.[1, 11] The factors giving rise to cancer are generally accepted to be irritants, chemical, biochemical, or radio-active substances. Of these, the most common, especially in cancer of the mucous tracts, are the biochemical or the bacterial elements. Thus malignancy of adenomas, papillomas, or polypi of the intestinal tract is due to the more persistent and virulent action of the infecting organisms, or to the increased trauma which is necessarily accentuated by the passage of the fæces, and possibly by the compression of the bowel itself in its effort to pass on both fæces and polypi. This explanation of the formation of carcinomatosis, of course, assumes the condition to be due to an intestinal infection.

A natural question to ask would be, "Are all multiple polypi of the intestinal tract likely to become carcinomatous; if not, which forms are

especially dangerous?" Because of the high rate of malignancy in diseases of the colon, no tumor should be considered benign until proof to the contrary is established. Mummery stated that "almost all recorded cases of multiple polypi of the colon had eventually become malignant, and this was a factor to be reckoned with in treating these cases." If the tumor is associated with intussusception, the safest procedure which can be followed to prevent a recurrence is the removal of the section of the bowel which is involved.

The confusion apparent in the classification of the polypi likewise exists in the determination of malignancy. Polypi of the nasal passages and of the intestinal tract are similar in structure, although the former very rarely, if ever, become malignant. The latter, existing under entirely different circumstances, are submitted to traumatism, stress and strain, and the action of bacteria. In the twenty-six cases of malignancy reported by Doering and by Soper, adenocarcinoma was the type of cancer found in each. In the adenomas, as in the papillomas, the stroma is the essential part. Simple irritative and regenerative hyperplasia, adenomatous growth, and carcinoma are successive stages which are manifested by the same kind of tissue; the differences are those of degree of development and not of kind. Loosely speaking, we may regard carcinoma as an adenoma or papilloma which has developed into a malignant growth. In the intestinal tract the adenomatous type of growth certainly predominates, according to the statistics of Soper, 43 per cent.

INTUSSUSCEPTION

In this series of thirty-nine cases there was but one of obstruction and none of intussusception. Only pedicled tumors can be held responsible for intussusception. If the tumors are intramural they tend to strengthen the wall of the bowel and to prevent its invagination. The contention that the mere weight and pulling of the tumor will produce the invagination is undoubtedly incorrect. Were this true, the tumor mass would always be found at the tip of the invagination, which is not the case. The pedicled growth is most common in children, and the fact that there were no cases of children in this series may account for the absence of cases of intussusception.

SYMPTOMS

Symptoms vary with the size, position, and number of the polypi. Generally, patients in whom the polypi are localized in the rectum and sigmoid have a sense of weight, a loaded feeling in the rectum, and occasionally tenesmus with or without bleeding. If the polypi are pedicled and low, they may protrude from the rectum, as in the case of Edwards; if unusually large numbers of polypi are present, prolapse of the rectum may occur as in the case of Norbury. Diarrhœa is practically always present. Diarrhœa and extensive involvement of the colon are usually associated with pus and blood. Involvement of the colon often causes a

vague abdominal pain which may be localized at the seat of the involvement. A complete or partial obstruction of the bowel will result in stasis and the formation of toxins which have an inhibitory action on the proximal section and cause distention. If this is progressive, symptoms other than those at the original site of involvement may mask the real condition. Frequently the symptoms of colonic lesions resemble those of gastric or duodenal ulcers because of the effect of food on the stomach.[13] A large percentage of painful lesions of the colon give pain in the ascending colon, around the cæcum and the appendix. Sooner or later there is loss of weight; the anæmia which develops varies with the degree of bleeding. The so-called essential hemorrhage occurred in but three of our series of cases. Repeated attacks of colic with obscure etiology and symptoms pointing to obstruction suggest polyposis.

TREATMENT

Since no specific etiologic factor is known, the treatment of intestinal polyposis varies with the individual case. If the polypi are localized in the rectum, cauterization may be practised. The patients should be kept under observation and if any signs of malignancy develop, resection of the rectum should be performed. If operation is indicated, it undoubtedly offers the best results.

CONCLUSIONS

1. Multiple polyposis of the intestinal tract is a serious disease from the standpoint of morbidity and mortality.

2. The etiology of the intestinal polypus is not known, although chronic ulcerative colitis and intestinal infections appear to be factors.

3. There is no specific medical treatment and operation undoubtedly offers the best results in the more advanced cases.

4. The rectum, the sigmoid, and the splenic and hepatic flexures are most frequently involved. The small intestines are rarely involved.

5. The predominant symptoms are diarrhœa, with the passage of pus and blood, vague abdominal pain, and rectal tenesmus. The so-called essential hemorrhage, if present, is almost pathognomonic.

6. Proctoscopic examination[6, 7] should be done routinely in all cases of dysentery.

7. Adenomas do not seem to become malignant more often than polypi and papillomas.

8. In cases in which polypi were associated with carcinoma, they were usually found below the cancerous growth farther along in the intestinal tract.

9. Most marked involvement of the colon is found in the cases which begin as a mild diarrhœa and later become chronic. The more sudden and severe the onset the more localized the condition in the colon.

10. Multiple polyposis of the intestinal tract is more frequent in males than in females, a proportion of 2 to 1.

BIBLIOGRAPHY

[1] Back, I.: Case and Specimen of Multiple Polypi of the Colon Becoming Carcinomatous. Proc. Roy. Soc. Lond., 1913–1914, vii, Surg. Sect., 193.

[2] Bratrud, T.: Intestinal Polyposis With Report of Case with Three Intussusceptions. Surg., Gynec. and Obst., 1914, xix.

[3] Carroll, W. C.: Intestinal Polyposis. Surg., Gynec. and Obst., 1915, xx, 412–414.

[4] Collier, W.: Multiple Polypi of the Stomach and Intestine. Brit. Med. Jour., 1895, ii, 973.

[5] Doering, H.: Die Polyposis intestini und ihre Beziehung zur carcinomatösen Degeneration. Arch. f. klin. Chir., 1907, lxxxiii, 194–227.

[6] Drueck, C. J.. How to Examine the Rectum and Interpret its Findings. Internat. Clinics, 1916, 26 s., iii, 242–254.

[7] Drueck, C. J.: Applied Anatomy of the Terminal Bowel. Interst. Med. Jour., 1919, xxvi, 92–100.

[8] Furnivall, P.: Three Cases of Multiple Polypi of the Rectum and Large Intestine. Proc. Roy. Soc. Lond., 1913–1914, vii, Surg. Sect., 245–246.

[9] Hertz, A. F.: Four Cases of Rectal Polypus Occurring in One Family. Proc. Roy. Soc. Lond., 1913–1914, vii, Surg. Sect., 255–256.

[10] Hewitt, J. H., and Howard, W. T.: Chronic Ulcerative Colitis With Polyps. A Consideration of the So-called colitis polyposa (Virchow). Arch. Int. Med., 1915, xv, 714–723.

[11] Kanthack, A. A., and Furnivall, P.: Multiple Polypi of the Small Intestines. Tr. Path. Soc. Lond., 1897, xlviii, 83–85.

[12] Logan, A. H.: Chronic Ulcerative Colitis, a Review of One Hundred and Seventeen Cases. Northwest Med., 1919, xviii, 1.

[13] Mallory, W. J.: Colon Lesions. Virginia Med., 1917, xxii, 137.

[14] Murphy, J. B.: Polyposis of the Sigmoid. Surg. Clinics of Chicago, 1916, 477–481.

[15] Newbolt, G. P.: Case of Multiple Adenomata of the Colon and Rectum. Proc. Roy. Soc. Lond., 1913–1914, vii, Surg. Sect., 272–274.

[16] Norbury, L. E. C.: Case of Multiple Polypi of Rectum and Colon. Proc. Roy. Soc. Lond., 1913–1914, vii, Surg. Sect., 195–196.

[17] Oden, R. J. E.: Intussusception of the Jejunum Associated With Two Pedicled Fibro-Adenomata. Surg., Gynec. and Obst., 1919, xxix, 489–492.

[18] Orth, J.: Ueber Colitis cystica und ihre Beziehung zur Ruhr. Berl. klin. Wchnschr., 1918, lv, 681–687.

[19] Preble, W. E.: Intestinal Uræmia and Sequelæ. Boston Med. and Surg. Jour., 1917, clxxvi, 296–307.

[20] Soper, H. W.: Polyposis of the Colon. Am. Jour. Med. Sc., 1916, cli, 405–409.

[21] Watson, C. G.: Case of Multple Adenomata, Associated Wth Columnar Carcinoma of the Pelvic Colon. Proc. Roy. Soc. Lond., 1913–1914, vii, Surg. Sect., 194–195.

A CASE OF DIAPHRAGMATIC HERNIA OBSERVED POST-MORTEM

By Lyman Foster Huffman, M.D.
of Cleveland, Ohio
from the anatomical laboratory of the western reserve university medical school

Diaphragmatic hernia is not as uncommon as was formerly supposed and recently the number of cases has been considerably augmented by war wounds of the diaphragm. Nevertheless it seems advisable to report this case because of some unusual anatomical relations.

The great majority of cases of diaphragmatic hernia occur on the left side. The right lobe of the liver aids in the closure of the right side of the diaphragm and reinforces it so that hernia is prevented from occurring at weak places or defects in this part of the diaphragm.

Diaphragmatic hernia is commonly classified as to whether the case is congenital or acquired and whether it is true or false, a false hernia being one in which there is no sac.

In the acquired form a direct injury to the diaphragm by stab or bullet wound is frequently the etiological factor. In many others there is a history of trauma to the abdominal wall, such as a sudden forcible bending of the body. In such cases a rupture of the diaphragm presumably occurs at its weakest point. This weak point is frequently the hiatus of the diaphragm where the lumbar and costal portions meet. It may also be the anterior part of the muscle at the junction of the costal and sternal portions. Less frequently it is at one of the normal openings of the diaphragm—the œsophageal opening.

That part of the diaphragm in the region of the œsophageal opening develops from the mesentery of the foregut. It is always in intimate contact with the œsophagus and there is no "opening" at the œsophageal opening in the literal sense of the term. There is a weak place where the diaphragm has developed about the œsophagus. If the stomach were to develop at a higher level than normal, or the diaphragm at a lower level, the opening in the diaphragm for the passage of the alimentary canal would be larger in order to accommodate the stomach. The stomach would require more space than the œsophagus, and the space would not always be completely utilized. It would be closed by loose connective tissue instead of the muscular elements normally fitting snugly about the œsophagus. The probability of hernia occurring in the location would be increased. A case of development of the stomach within the thorax has been recently reported and indicates that the level at which the stomach develops with respect to the diaphragm may be variable and may have a bearing on the production of diaphragmatic

[1] Baily, P.: A Case of Thoracic Stomach. Anat. Rec., xvii, 2, p. 107, Oct., 1919.

hernia in this locality. In this case[1] the œsophagus ended at the level of the third costal cartilage, and the stomach was situated within a sac in the posterior mediastinum. The sac was lined with serous membrane continuous with the peritoneum. The explanation offered for this condition was that the anlage of the stomach had been situated too far cephalad in the foregut.

The case which I wish to report was found on the dissecting table and no clinical history was obtainable beyond the fact that the subject was a woman fifty years old, who died a few hours after her admission to a hospital with symptoms indicating a myocardial insufficiency.

When the abdomen was opened the great omentum was seen to be drawn up into the left upper quadrant. The proximal part of the omentum and the pyloric portion of the stomach passed from the thorax into the abdomen through an opening in the diaphragm corresponding to the œsophageal opening. This opening was located opposite the twelfth thoracic vertebra and admitted three fingers.

The anterior aspect of the opened thorax was perfectly normal. The appearance of the thoracic contents from behind is shown in Fig. 1. The sac containing the stomach was in the posterior mediastium directly behind the heart. It straddled the aorta and bodies of the vertebræ, being a little more on the left than on the right side, and extended from the lower border of the eighth to the lower border of the eleventh thoracic vertebræ. The lining membrane of the sac was continuous with the peritoneum and there were no communications with or adhesions to the pleural or pericardial cavities.

The appearance with the sac opened is shown in Fig. 2. The stomach is seen to form a loop with its convexity, corresponding to the greater curvature, directed upward. The anterior aspect of the stomach, which in this case corresponded to the lesser curvature and part of the cardia, was firmly adherent to the anterior wall of the sac, so that the stomach could not be dislodged and drawn downward into the abdomen.

The blood supply is indicated in the accompanying diagram. (Fig. 3.) The right and left gastroepiploic arteries arose normally from the gastroduodenal and splenic arteries respectively. The hepatic and splenic arteries were the only branches of the cœliac axis, the coronary or left gastric arising directly from the aorta at a higher level. Near its origin the left gastric gave off the right and left phrenic arteries and then took a tortuous course between the anterior wall of the stomach and the sac. The aorta had the appearance of being twisted to the left, as its intercostal arteries arose from the right instead of from the dorsal aspect.

The œsophagus passed behind the root of the left lung and in the lower part of its course was closely applied to the right lateral aspect of the sac between it and the mesial aspect of the right lung.

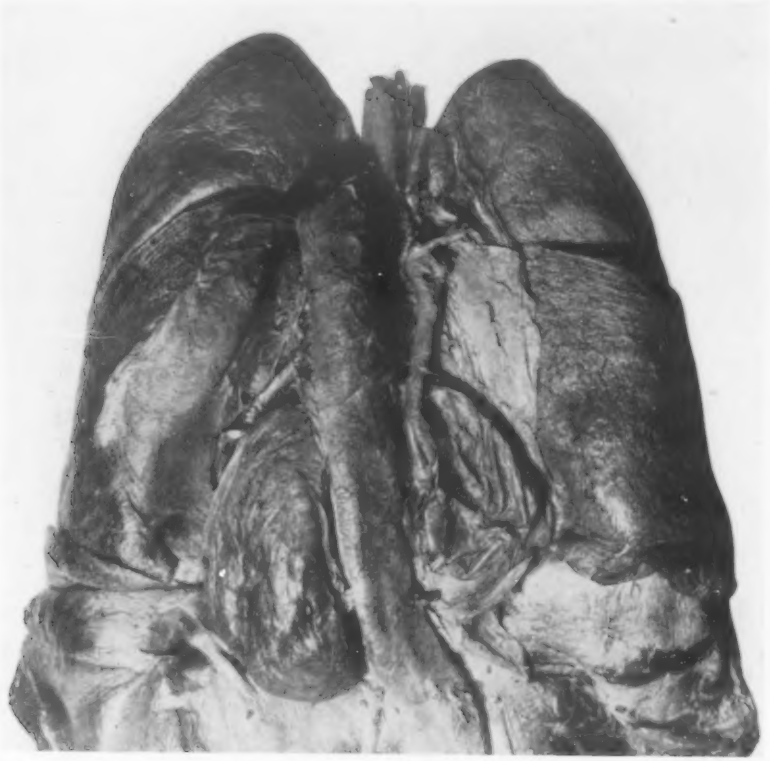


FIG. 1.—Posterior aspect of thoracic contents showing hernial sac in posterior mediastinum in front of the aorta and behind the heart.

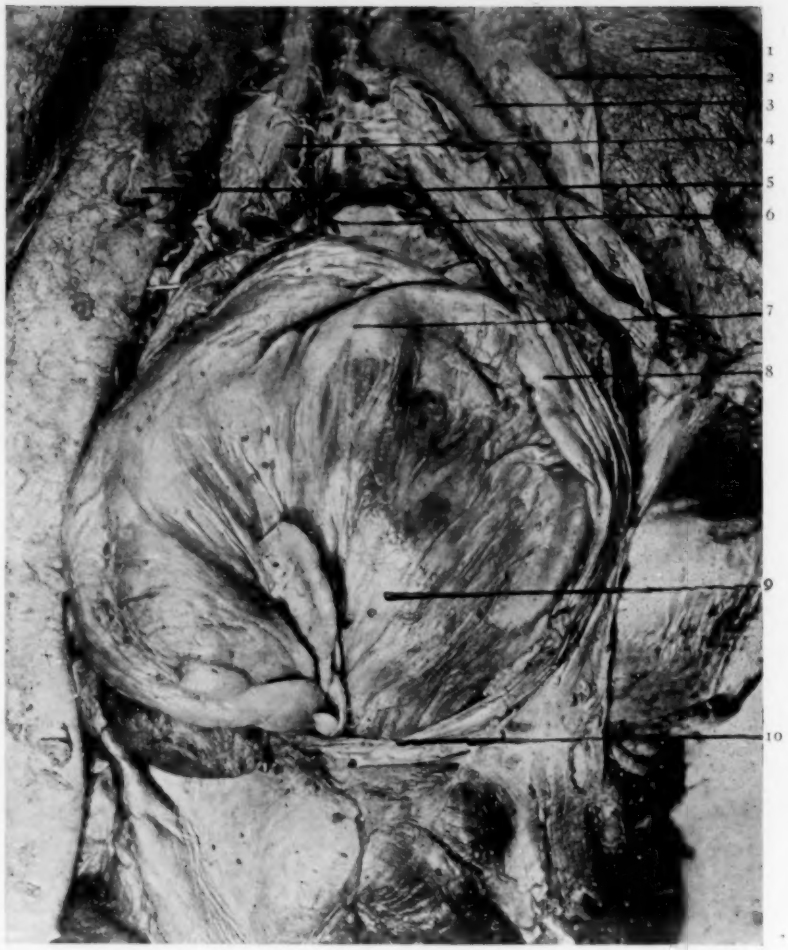


FIG. 2.—The thoracic contents viewed from behind. The aorta is drawn to the left. The hernial sac is opened. 1. Right lung. 2. Right parietal pleura. 3. Azygos vein. 4. Œsophagus. 5. Aorta. 6. Right vagus nerve. 7. Greater curvature of stomach. 8. Reflected hernial sac. 9. Great omentum. 10. Hernial opening in diaphragm, corresponding to the œsophageal opening, transmitting pylorus and great omentum.

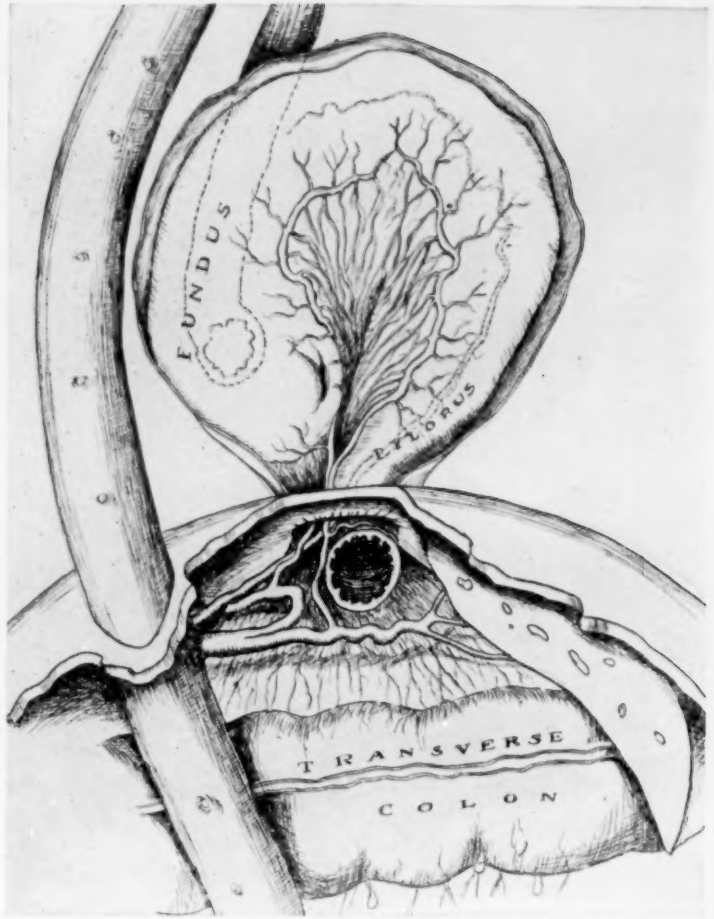


FIG. 3.—Diagrammatic view of the opened hernial sac from behind. The aorta is drawn to one side. We are looking forward at the greater curvature of the stomach arching upward. The lesser curvature is incorporated with the anterior wall of the sac, and in this location runs the coronary (left gastric) artery represented by dotted lines. The course of the œsophagus in front of the stomach with its point of entrance into the stomach is also indicated by dotted lines. The right and left gastro-epiploic arteries take their customary course along the free border of the stomach at the attachment of the great omentum. It is seen that the left gastric arises independently from the aorta above the cœliac axis. The cœliac axis has two branches, the hepatic running to the right giving off the gastroduodenal from which the right gastro-epiploic arises, and the splenic giving rise to the left gastro-epiploic.

It penetrated the sac to enter the stomach 3 cm. above the opening in the diaphragm.

The course of the left vagus was normal. The right vagus passed from the œsophageal plexus along the external aspect of the right side of the sac to about its middle, where it penetrated the sac, turned backward and could be traced for only a short distance in the region where the anterior aspect of the stomach was incorporated with the anterior wall of the sac. As this normally would be gastrohepatic omentum, it probably passed on to enter into the formation of the hepatic plexus.

The origins of the diaphragm were normal and there was nothing noteworthy about this muscle except the large œsophageal opening through which the pylorus entered the abdomen and the occurrence of a well-marked hiatus on the right side.

It is interesting to note that in addition to the diaphragmatic hernia this subject had a right labial and left interstitial hernia. The foramen ovale was patent. There were only eleven thoracic vertebræ and eleven ribs. The fifth lumbar vertebra was fused with the first sacral on the left side (lumbosacral vertebra).

This case is one of true diaphragmatic hernia occurring through a congenitally weak œsophageal opening. Possibly the diaphragm was weak at this point because the stomach developed more cephalad than usual and required more space in the "œsophageal opening" than would have been needed by the œsophagus itself. This explanation is suggested by the fact that the œsophagus ended above the "œsophageal opening" in the diaphragm. The case reported by Bailey, referred to above, suggests the plausibility of this explanation and its applicability to other cases of diaphragmatic hernia at the œsophageal opening.

The gastrohepatic omentum, lesser curvature, cardia and finally all of the stomach except the pylorus were herniated into the chest. That the gastrohepatic omentum was first drawn into the thorax is indicated by the firm incorporation of its normal attachment, the lesser curvature, with the anterior wall of the sac. The peculiar relationship of the right vagus to the hernia is also explained by the assumption that the gastrohepatic omentum through which the right vagus courses on its way to the hepatic plexus was drawn into the thorax first and entered into the formation of the hernial sac.

HERNIA OF THE DIAPHRAGM*

By Frank S. Mathews, M.D.
and
H. M. Imboden, M.D.
of New York, N. Y.

In view of the considerable number of recent papers dealing with the subject of hernia of the diaphragm, it will only be necessary in this article to describe a case with the X-ray findings, and call attention to some of the points of interest.

Mrs. W. P., aged fifty-five years, multiparous, at the time of operation was a woman in apparently good health and stout, rather than muscular, with a history of recent increase in weight. The symptoms relating to the present difficulty date back through ten years.

First, almost daily, after eating a meal, she would put her finger down her throat to encourage the expulsion of gas, which gave her a feeling of oppression in the chest.

Second, during the entire ten years, at intervals of from a day to three months, but without any regularity, she had attacks of pain following eating. The pain was severe, epigastric or higher and largely referred to the heart. She became pale and pulse was said to become weak. To onlookers she appeared to be strangling. She would make efforts to belch gas and if she succeeded the pain was immediately relieved. In some cases it required an hour or two before any gas was evacuated.

Third, by degrees she learned to modify her diet so as to limit the distress after meals, though she could not prevent the acute, severe attacks. The type of meal that gave her least discomfort was one of concentrated food and small bulk—that is, meat, potatoes and eggs, with no soups, desserts or green vegetables. These attacks began abruptly ten years ago and have continued without any noticeable change in the character, severity, or frequency of the attacks.

Three years ago a series of X-ray pictures was made on which was based the diagnosis of diaphragmatic hernia. The patient was referred for operation by Dr. W. A. Bestedo, who confirmed the presence of the stomach in the chest by physical examination. The X-ray report made November, 1916, by Dr. H. M. Imboden is as follows:

The stomach is entirely above the diaphragm and is in the right lower portion of the thorax, extending about two inches to the left of the left sternal line. The upper border of the stomach is about eight inches above the right diaphragm. The stomach and the colon are posterior to the heart. The opening into the sac is in the posterior portion of the diaphragm near the midline. The pylorus pro-

* Read before the American Surgical Association, May 5, 1920.

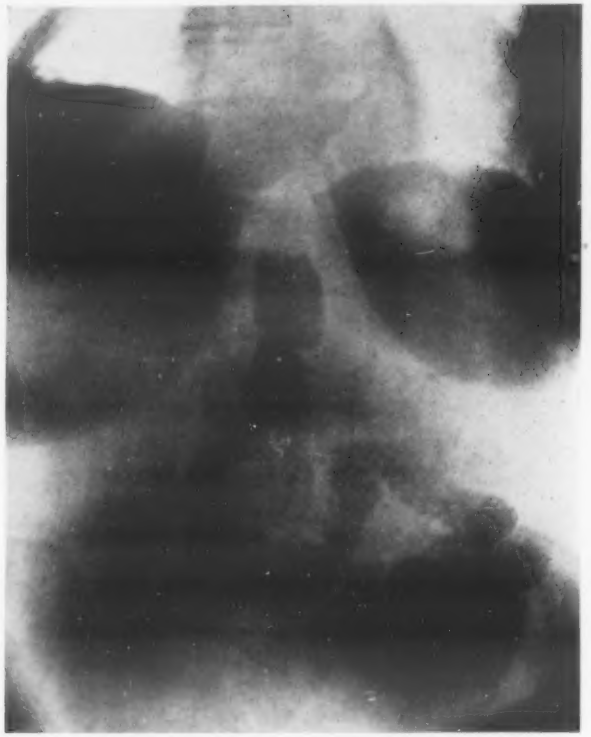


FIG. 1.—Stomach in thorax, behind and right of heart.

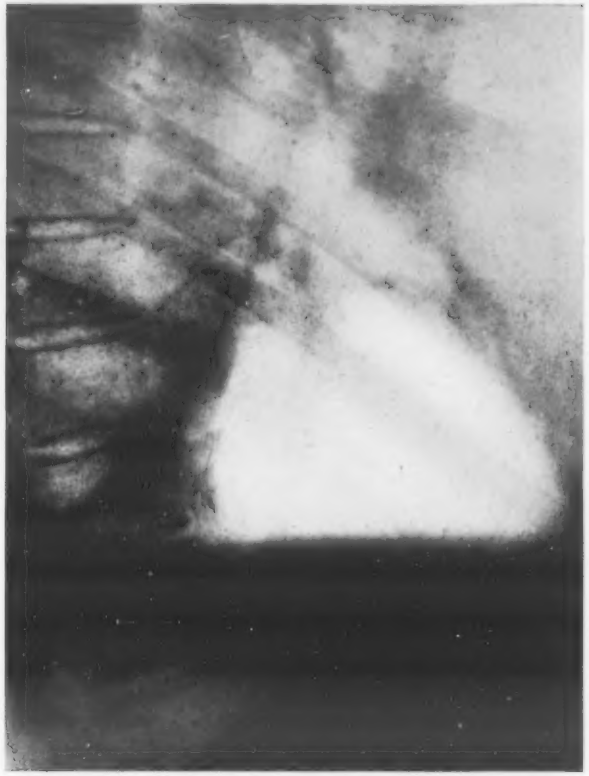


FIG. 2.—Stomach, side view, containing air and bismuth.

FIG. 3.—Distended colon, mainly in right chest.

FIG. 4.—Side view of the same.

FIG. 5.—One year post-operative. Stomach mainly in abdomen.

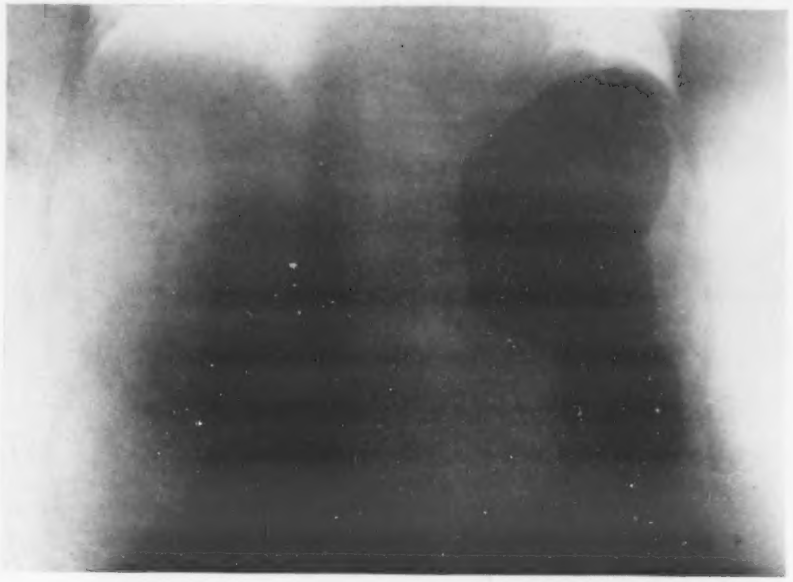


FIG. 6.—One year post-operative. Colon entirely in abdomen.

jects down toward the pelvis, parallel to the spine. The duodenum is also directed downward. The second portion of the duodenum is directed down. The third portion is transverse and the fourth portion is directed upward but joining the jejunum at the level of the third lumbar vertebra on the left side.

There is no evidence of disease about the pylorus or the first portion of the duodenum, but at no time were we able to get a satisfactory shadow of that portion of the stomach passing through the ring.

The stomach empties itself rather slowly. Seven hours p. c. there is a slight residue in the stomach.

The meal passes rapidly through the small intestine.

Three hours p. c. some of it is already in the hepatic flexure region.

Thirty-six hours p. c. most of it was discharged with the exception of a quantity in the descending colon, sigmoid and rectum.

An opaque enema revealed an unusually long transverse colon, most of which is in the hernial sac. We found no evidence of obstruction or occlusion of the colon, though where the two limbs pass each other in the ring, they are in rather close apposition.

Some of the plates of the colon indicated that a portion of it occasionally slips out of the sac.

The only explanation we can give to account for the patient's discomfort is the enormous gas bag in the stomach, which lies above the œsophageal opening. We fail to find any evidence of disease in any portion of the alimentary tract.

Operation (Mathews) was performed December 17, 1918, under intratracheal anæsthesia. Incision eight or nine inches in length in the left mid-rectus line from the costal margin downward. The patient was put in the position of a reversed Trendelenburg. No part of the colon was in the hernial sac. More or less of the stomach was, and it was drawn downward entirely out of the hernia without great difficulty. Its wall was thick and leathery. The hernial opening was the enlarged œsophageal one. Because of the depth of the abdomen due to the patient's large size and obesity, it was not easy to expose the orifice to sight. Two mattress sutures of heavy chromic gut were with difficulty placed at the anterior margin of the ring. The ring was at least two inches in diameter and by means of the stitches seemed to be considerably narrowed. The stomach was then sutured to the whole length of the abdominal incision. It was drawn downward as far as possible, and the first suture was inserted through the post-rectus sheath and peritoneum, and included a bite of the stomach wall just in front of the lesser curvature high up toward the cardia. The suturing was continued down obliquely across the front of the stomach for a distance of about eight inches. Sutures were placed about one-half inch apart and took a firm hold on the stomach wall. The remaining layers of the abdominal wall were closed with silkworm and catgut. Patient was kept in bed two weeks with the head of the bed elevated, and on discharge from the hospital was advised to restrict diet and encourage catharsis in order to keep down intra-abdominal tension.

At the present date, May 1, 1920, the patient has been entirely free from attacks, has abandoned her diet of small bulk, is not compelled to belch after eating, and now eats anything. Her weight is

considerably increased. X-rays taken after bismuth meal a few days ago by Doctor Imboden show that the stomach stands almost vertically as though still adherent to the abdominal wall for the length of the suture line. A small portion, possibly the upper fourth, is in the chest. Bismuth enema shows that the long splenic flexure and transverse colon which formerly entered the thorax now lie to her left and entirely below the diaphragm.

Comment.—The case is interesting from a number of standpoints—not the least being that the distressing symptoms of ten years' duration have been completely relieved by an operation of no great severity and which did not remove the sac nor could it close the ring, both because of technical difficulties and because it was the normal opening for the passage of the œsophagus. The patient's milder attacks or discomfort were evidently due to an air-filled stomach occupying space intended for the lungs. The more severe attacks would seem to have been due to a greater distention of the stomach with food and air and not unlikely a mild sort of strangulation. In entering the sac the stomach seems, according to X-ray evidence, to have turned over on a transverse axis, so that the greater curvature lay higher in the chest than the œsophageal opening and so kinked the entrance of the stomach that emptying itself of air through the œsophagus became difficult or for a time impossible.

In the literature these hernias are usually recorded as occurring through the left diaphragm and usually occupying the left part of the chest, pushing the heart to the right. In this case the heart was not displaced and nearly all of the sac was in the right chest. A hand could be inserted a short distance into the hernial sac, but obtained no evidence of communication with the pleura, as is at times found, especially in congenital cases.

Intratracheal anæsthesia was very satisfactorily employed and is highly desirable because of a possible communication between peritoneum and pleura. The positive pressure in conjunction with the reversed Trendelenburg position was a great aid in keeping the contents of the sac reduced. Even then, there was quite a tug upon the stomach with each inspiration. It is worthy of comment that this hernia of at least ten years' duration was without adhesions, though the stomach wall showed very noticeable departure from the normal, and it is rather remarkable that the colon should have been able to enter the chest to such an extent through a rigid ring and not have given rise to any symptoms. In entering the chest it would seem to have passed up in front of the stomach, and the purpose in suturing the stomach to the abdominal wall was as much to keep the colon as the stomach from entering the hernia.

DIRECT INGUINAL HERNIA*

By J. Pierre Hoguet, M.D.
of New York, N. Y.

A great deal has been written about the etiology and treatment of most forms of hernia in recent years, and yet when one considers the frequency of this condition, the amount of literature on the subject is small in proportion to that of even less common diseases. And this is even more noticeable when one attempts to review the literature of the very important subject of direct inguinal hernia, for except for the papers of Schley and of Downes on this subject, practically nothing has been written. It would seem as though surgeons were satisfied with the operative treatment of direct hernia and that they considered the average results so good that they need not be improved upon. And yet, unfortunately, this is not the case; the percentage of recurrence after operation for all kinds of hernia is yet much too great, and this is especially true after the ordinary operations that are done for direct hernia. It is with the idea of renewing interest in the subject of direct hernia that this matter is again brought up, and an operation, that has been tried out for the last two years and seems to promise good results, is presented.

As a general rule, it is in the middle-aged male that direct hernia occurs, although it is occasionally found in women and in children. There is no question but that indirect and direct hernia very often coexist in the same patient, and in the very large hernias there is most often a good-sized direct and an indirect sac. In the massive ones, such as are shown in the accompanying figures, the deep epigastric vessels are indistinguishable, so that the two sacs become one. It is impossible, in these cases, to say whether the hernia started internal or external to the deep epigastric vessels, but in either case, the result is the same, that is, a giving way of the whole inguinal canal. As will be mentioned later, even when the direct hernia is of only moderate size, an indirect sac always exists, either as a definite sac or as a small protrusion of peritoneum external to the deep epigastric vessels. Another point, which although recognized, is not regarded seriously enough, is that of the presence of the urinary bladder in the direct sac. This naturally becomes of the greatest importance in the operative treatment, and it is the conviction of the writer that a portion of the bladder is practically always present in the inner part of the direct sac.

* Read before the New York Surgical Society, May 12, 1920.

The question of operative treatment of direct inguinal hernia is of the greatest interest, and here it should be stated that, in some of these cases, there is no doubt that permanent cures can be obtained from the simple Bassini operation. These are the cases one occasionally sees where the direct sac is not very large and where there is enough bulk of internal oblique and transversalis muscle, so that when these are sutured to Poupart's ligament, there is a posterior wall for the canal of enough thickness from the internal ring to the spine of the pubis. It is probable, however, that these cases are in the minority, and in the usual direct hernia one finds a good-sized sac internal to the deep epigastric vessels and an internal oblique and transversalis muscle that is represented by a few small bundles of muscle tissue only loosely connected together. It is with the idea of reinforcing these insufficient muscles that other operations have been proposed, the best, of course, being that of reinforcing the posterior wall of the canal by suturing the lower portion of the rectus muscle to Poupart's ligament. There are certain cases where this is a very good operation, and as can be seen from the writer's cases, it has given fairly satisfactory results, but it would seem that suturing the rectus muscle, with or without its sheath, to Poupart's ligament pulls the muscle out of its normal anatomical line and that the constant tendency would be for it to pull away from its new attachment when it contracts. Then again, the conjoined tendon must be sutured to Poupart's ligament as well as the rectus, and sometimes when a large number of sutures are introduced into the ligament, it splits and separates into a number of strands which really afford little support for the muscle.

Schley, in his paper on direct hernia, unfortunately, gives no figures as to recurrence in his cases. He simply states that he knows of no recurrences, although admitting that his cases have not been traced. Downes is of the opinion that there is usually about ten per cent. of recurrences after direct hernia operations, and in a paper published by Dr. W. B. Coley and the writer, in the ANNALS OF SURGERY for September, 1918, which was a review of 8589 cases of hernia that had been operated upon, the statement was made, that if patients who had been operated upon for direct hernia could be followed up for a period of at least two years, a percentage of recurrence of from ten to fifteen would be found. This statement seems to be substantiated by the results seen in some of our larger hospitals since the follow-up systems have been inaugurated.

About two years ago, when it was realized that the results of operations on direct hernias were so bad, an endeavor was made to improve upon them by reinforcing the posterior wall of the canal by the use of the aponeurosis of the external oblique, so that there would be in the repair of the hernia three distinct layers instead of two, as in the ordinary

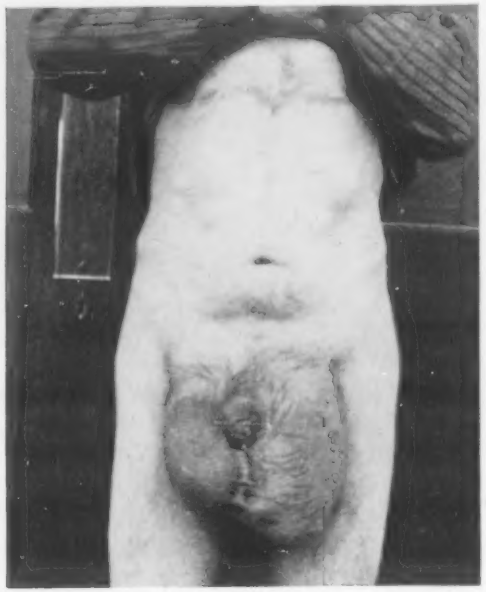


FIG. 1.

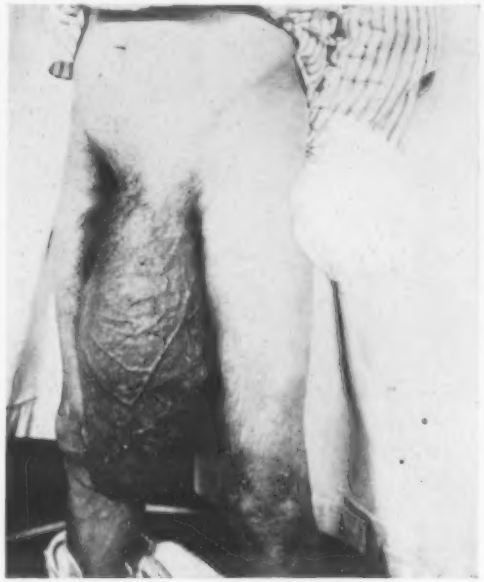


FIG. 2.

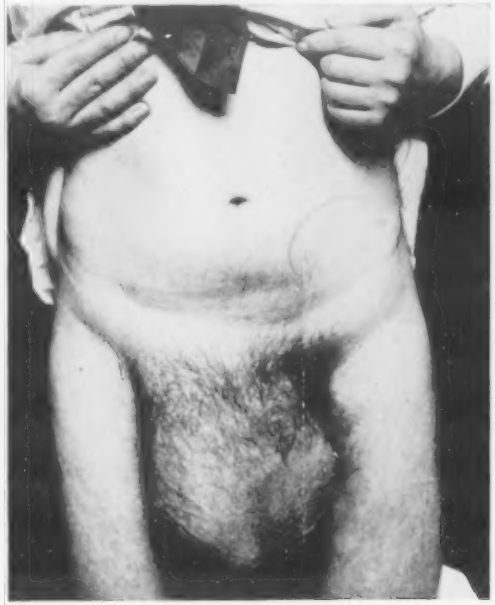


FIG. 3.

Examples of massive hernias of the direct and indirect type, in which the deep epigastric vessels are not distinguishable at operation.

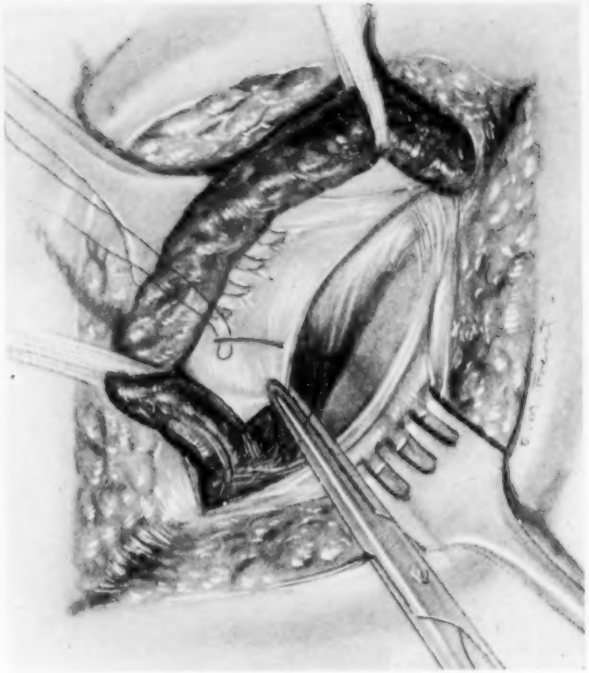


FIG. 4.

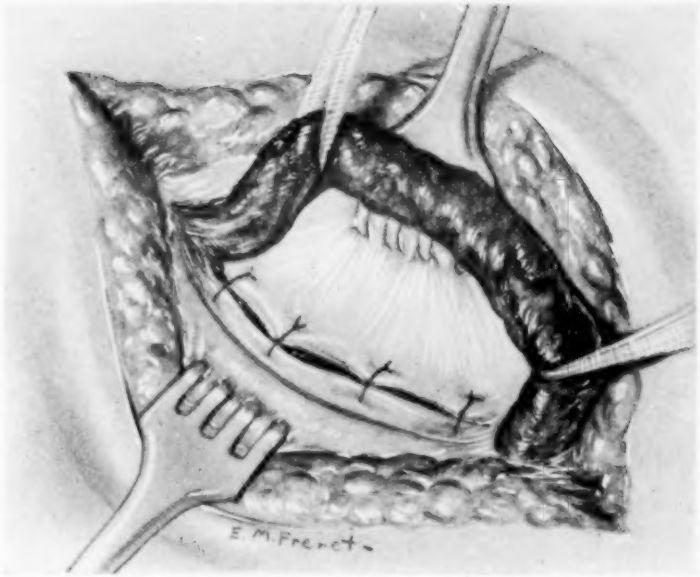


FIG. 5.

Showing how the sutures are introduced through both the reflected portion of the aponeurosis of the external oblique and the conjoined tendon and how these structures are sutured to Poupart's ligament.

Bassini operation. But the principle was always borne in mind that the same operation could not be made to fit every patient, so that in some cases the simple Bassini was done, in others the Bassini with transplantation of the rectus, and in the others the Bassini with the suture of the reduplicated aponeurosis of the external oblique. This operation, which was found to be particularly useful in those cases where the internal oblique and transversalis were very weak or where the rectus was very narrow, is done as follows: The usual skin incision was made and the aponeurosis of the external oblique split from the external ring upwards in the line of its fibres. As mentioned before, an indirect sac always can be found in these cases, although it may be very small. This sac is separated from the elements of the cord and opened. It has not been found necessary to divide the deep epigastric vessels, but by traction outwards on the indirect sac, all of the peritoneum of the direct sac may be pulled external to the vessels and the two sacs converted into one. By this proceeding, all possibility of injuring the bladder is eliminated, for as the peritoneum of the direct sac is pulled outwards under the epigastrics, if the bladder folds are adherent to the under surface of the sac, they can be clearly seen. This redundant peritoneum of indirect and direct sac is then transfixed with a suture and cut away. The steps up to this point are applicable to all cases of direct hernia, but the actual repair of the deficiency must depend upon the bulk of the internal oblique and transversalis. When the latter muscles are strong, there can be no objection to doing the ordinary Bassini which will probably give a permanent cure. In the majority of cases of direct hernia, these muscles are weak, and it then becomes necessary to reinforce them. As a double reinforcement, the reduplicated aponeurosis of the external oblique is used in the following way: The upper edge of the aponeurosis is pulled upwards and toward the midline with a sharp retractor, thus making a folded edge of fascia, lying parallel to Poupart's ligament and about one-half inch above the lower border of the internal oblique muscle. The sutures, preferably of kangaroo tendon, are then introduced through this folded edge of aponeurosis, the internal oblique and transversalis, and then through Poupart's ligament from behind forwards, posterior to the cord. It has been found very useful to use a blunt retractor in the lower angle of the wound in order to expose the lowermost portion of the canal which is essentially the weakest and which should be completely visible when the most internal suture is introduced. One suture should be inserted above the exit of the cord, making a new external pillar to the new internal ring, either in the way described above or simply through the internal oblique and transversalis, if these are strong enough at this point. The upper leaf of the aponeurosis is then brought over the cord and sutured to the lower leaf and the skin and subcutaneous tissue then closed.

The results of operation in 142 cases of direct hernia are given below in tabular form, and it can be seen that the percentage of recurrence from the simple Bassini is 7.3 per cent., from the Bassini with rectus transplantation 2.8 per cent., and from the Bassini with suture of the reduplicated aponeurosis 2.5 per cent.

	Cases	M.	F.	Adults	Children	R. E. C.	Known to be well	Not traced	Died
Bassini	68	65	3	65	3	5	41	21	1
Bassini, with rectus transplantation	35	33	2	34	1	1	16	18	
Bassini, with suture of reflected aponeurosis	39	38	1	39	0	1	29	8	1
Total	142	136	6	138	4	7	86	42	2

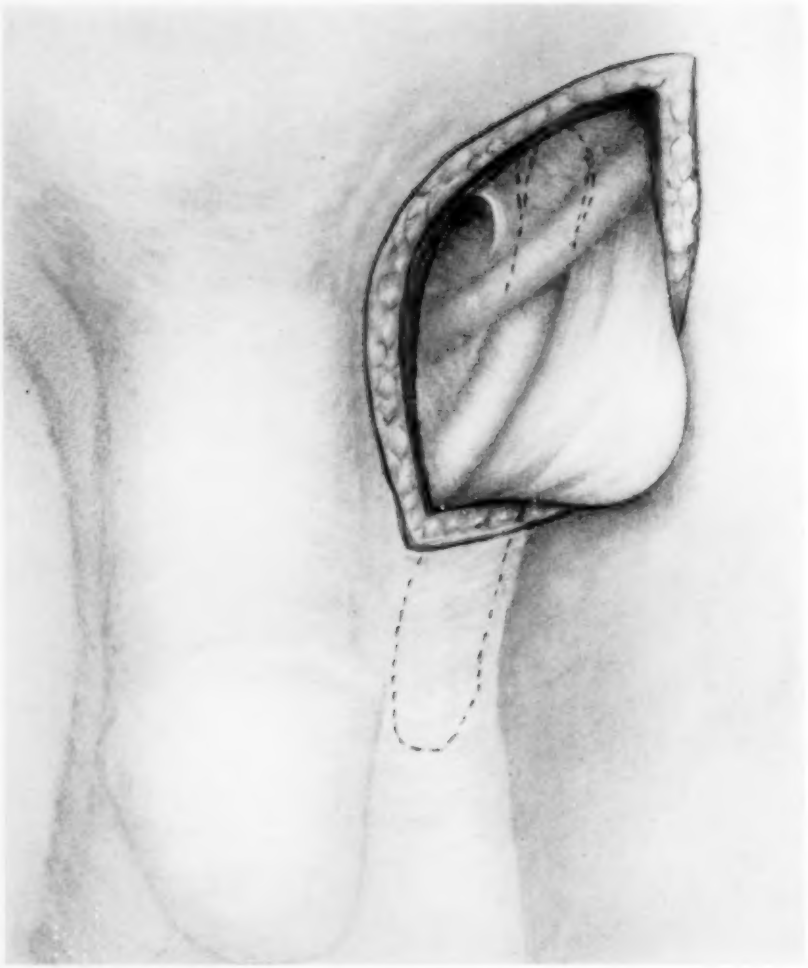


FIG. 1.—Showing protrusion of sac of inguinal hernia through the femoral ring.

DEVELOPMENT OF AN INGUINAL HERNIA THROUGH THE FEMORAL RING FOLLOWING DESCENT OF THE TESTICLE BY THE SAME ROUTE

By A. M. Fauntleroy, M.D.
Captain, Med. Corps, U. S. Navy

This case is reported on account of the fact that there is apparently no recorded instance in surgical literature where the testicle has descended through the femoral canal and into the scrotum.

C. E. R. A young man, aged twenty-two years, admitted to the surgical service, U. S. Naval Hospital, New York, N. Y., on October 22, 1919, with a diagnosis of complete left indirect inguinal hernia. The ward officer saw him on admission and at that time there was a distinct enlargement in the left inguinal region, extending into the scrotum.

The next day I examined this man, as a routine measure preliminary to operation, but no enlargement was visible in the inguinal region or scrotum, nor could any impulse be felt with the index finger in the external ring. Several other members of the surgical staff examined this man with the same result. In view of the fact that the ward officer had personally noted the inguinal and scrotal enlargement an operation was decided upon.

Operation (October 24, 1919).—Ether. The left inguinal region was exposed in the usual manner. When the aponeurosis of the external oblique muscle was divided the astounding fact was at first apparent that no cord was visible, although a testicle could be distinctly palpated in the scrotum.

After careful separation of Poupart's ligament from the internal oblique muscle the cord came into view descending vertically, passing through the femoral ring and *thence into the scrotum.* This anatomical arrangement explained why the impulse could not be elicited at the external ring. Once the anomaly was discovered the cord was lifted up and the sac dissected away, ligated at the internal ring and removed. The cord was buried, the internal oblique muscle sutured to Poupart's ligament in the usual manner, except that an effort was made to close the femoral opening (except for cord) from the inside by suturing the under side of Poupart's ligament to Cooper's ligament. The patient made an uneventful recovery and was discharged to duty in thirty days.

As a result of normal demobilization this man was discharged to civil life shortly after leaving this hospital. Several letters have been written to him at the address he gave for his parents in his health record, with the idea of following up his case, but these letters have remained unanswered.

My assistant at this operation was Lieutenant Samuel B. Burk, M.C., U. S. N. R. F., who has since been demobilized and is now practicing in New York, N. Y.

AN OPERATION TO FORM A NEW ANAL SPHINCTER AFTER OPERATIONS ON THE LOWER RECTUM

By Alfred J. Brown, M.D.
of Omaha, Neb.

One of the principal objections, if not the principal objection to the operation of perineal proctectomy devised by Quenu, is that this operation destroys the anal sphincter and leaves the patient with an incontinent bowel at the site of the anal orifice. There is no doubt that such a condition is far more disagreeable to the patient than an inguinal colostomy which can be protected and kept clean.

Attempts made to work above the sphincter, as in the Kraske operation and its various modifications, including the resection through the posterior vaginal wall, are not infrequently unsuccessful because of the tendency of stricture to follow the operation in low cancer and also owing to the inability to save the sphincter and at the same time excise the entire growth.

There are certain cases, rarely found, in which perineal proctectomy can be performed with comparative ease and the entire growth resected from below in which the patient can be spared the combined abdominal and perineal operation with attendant high mortality, provided sphincter control can be retained.

The statement has been made that with resection of the lower part of the rectum, incontinence results because of the removal of that part of the bowel supplied with sensory nerves and consequent loss of that sensation which notifies the patient of the desire for a bowel movement. In an experience of the two cases reported here this has not been the case. Both patients knew when the bowels were going to move and were able to control the bowel movement.

With the facts above in mind the operation described here has been employed in two cases, the only cases seen in which a low proctectomy seemed indicated and in each the new sphincter functioned almost from the time of operation; in the first case for a period of ten years, until the patient succumbed apparently from a recurrence of the cancer, and in the second case until recurrence of the growth formed a mechanical block to the passage of fæces and made a left inguinal colostomy necessary to prevent death from intestinal obstruction. The patients were both women and the operation will be described as performed in the two instances. The technic in the male would be but little different from the description here given.

The first steps of the operation are identical with the Quenu resection. The anus is cauterized and sutured. An incision beginning in front at the posterior commissure of the vagina passes backward to the

anus, encircles it, and passes backward to just behind the tip of the coccyx. The incision is deepened, excising the sphincter ani and exposing the rectum up to the levator ani muscle of either side. The rectum is separated from the vaginal wall in front by dividing the central tendon and from the coccyx behind. It was not found necessary to remove the coccyx in either of the cases. The inner margins of the levator ani on either side are separated from the rectal wall and the recto-vesical covering the upper surface of the muscles divided also. The rectum can then be drawn downward and backward through the incision and with the finger the rectum stripped away from the posterior vaginal wall as far up as the lower part of Douglas' cul-de-sac. The middle hemorrhoidal vessels will be found surrounded by a fibrous sheath lying internal to the levator ani and recto-vesical fascia. These are tied as they appear when the rectum is drawn down and divided between ligatures. The rectum is then forward and with the finger in contact with the sacrum the tissues behind the rectum, including the lymphatic glands, are separated from the sacrum as far up as the promontory and remain in contact with the rectum, thus making a block dissection of the rectum containing the growth and the glands situated in the hollow of the sacrum. Traction downward will now bring 4½ to 5½ inches of the rectum below the perineum. If this is sufficient to bring the healthy bowel above the growth down to the posterior margin of the perineal wound without strain it will not be necessary to open the peritoneum. If, however, enough of the bowel cannot be drawn down because of its peritoneal attachments and the mesorectum, the peritoneum is opened and the bowel drawn down a sufficient distance (Fig. 2). The cut edge of peritoneum is immediately sutured to the wall of the gut and the peritoneal cavity closed off after the bowel has been drawn down to its final position.

Thus far the operation has followed the technic of Quenu, but from this point on it differs. The margins of the levator ani are outlined and a strip of muscle is separated from each (Fig. 3). One of the strips is left attached anteriorly, the other posteriorly. The strips are approximately 1 inch wide and as long as the muscle allows. The incisions freeing these strips pass entirely through the muscle, but do not include the recto-vaginal fascia. The muscle strips are then changed from side to side (Fig. 4), so that the one originally on the right side now lies on the left and *vice versa,* and are sutured in place with interrupted sutures of chromic catgut. The rectum is amputated and its cut edge sutured to the cut edge of the circular skin incision, a gauze wick is inserted in the hollow of the sacrum and protrudes through the posterior incision, and the skin incision is closed with interrupted sutures (Fig. 5). In the illustrations the bowel is shown amputated before the muscle strips are separated. This was done for clarity of illustration. During the operation the amputation is not performed until after all deep work has been done and the superficial suture is being performed.

In the two cases which I have had, the post-operative shock has been very slight and the patients have been allowed up on the tenth day. The drainage was removed at the end of forty-eight hours, and the bowels moved by enema on the fifth day. After that there was slight incontinence for a week to ten days, and then the patients were continent and accidents did not occur.

Case I.—Mrs. B. S., aged sixty-four years. Married, housewife. Referred by Doctor Middleditch, of New London, New York. About six months ago she first noticed small amounts of blood in her stools and slight pain on defecation. There has been no obstruction to the passage of fæces and no change in size has been noted. The bleeding has become more marked and for the past two weeks she has noticed a foul odor to the stools. She has noticed no discharge between movements. Appetite is good. She has not lost weight. Has had no fever and aside from the local condition feels well.

Physical Examination.—The patient is a large fleshy woman with negative physical findings except for the local condition. There is no enlargement of the glands in the femoral or inguinal regions. Rectal examination (digital) reveals an ulcer of the anterior wall of the rectum. Its base is hard and nodular. Its edges are everted and also hard. The mass occupies the anterior wall of the rectum and its upper margin can be felt by the examining finger—its lower margin lies about 2 inches above the anal ring. It does not apparently involve the entire rectal wall and the rectum is movable on the posterior vaginal wall.

Operation was performed February 28, 1907, according to the above technic. After a short and uneventful convalescence the patient was well and completely relieved of her symptoms. Was able to do her housework and had no trouble with lack of bowel control. Examination one year after operation showed an anal opening which looked almost normal. Rectal examination revealed a sphincteric action to the levator ani muscles which could be tightened or relaxed at will. After this time the patient did not return for examination but reported through her daughter from time to time that she was well. Finally, ten years after operation, September 28, 1907, her death was noted in the paper and inquiry elicited the following information by letter:

"About two years ago she passed some blood and pus; it was so slight it could hardly be said to show a return of the old trouble. There was no pain with it at any time. For about two years she suffered with hardening of the arteries, so that the heart was affected. Also the respiration. She was able to be about the house until two weeks before her death, when she was taken ill with bowel troubles and vomiting. This (the vomiting) subsided in about three days before they were able to check the bowels. Until she passed away the discharge was nearly all blood and pus, it was almost a constant flow, she would have a sharp pain and the blood and pus would follow. There seemed to be no pain after the first

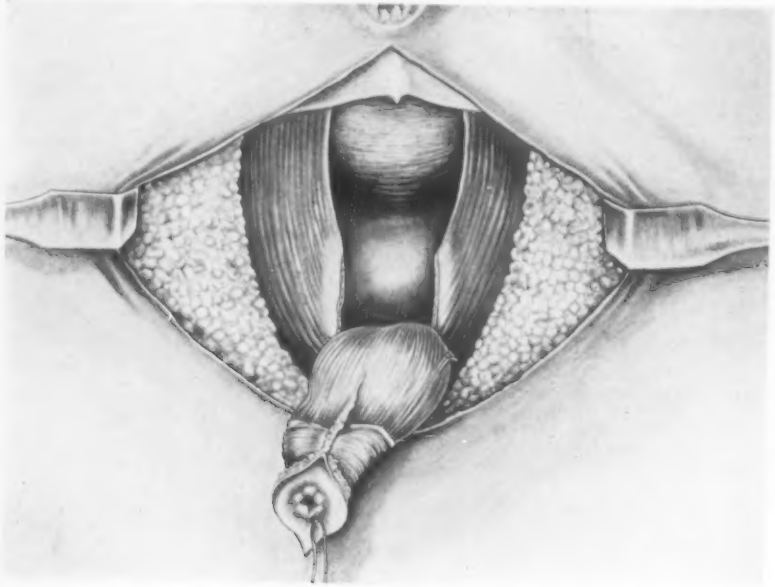


FIG. 1.

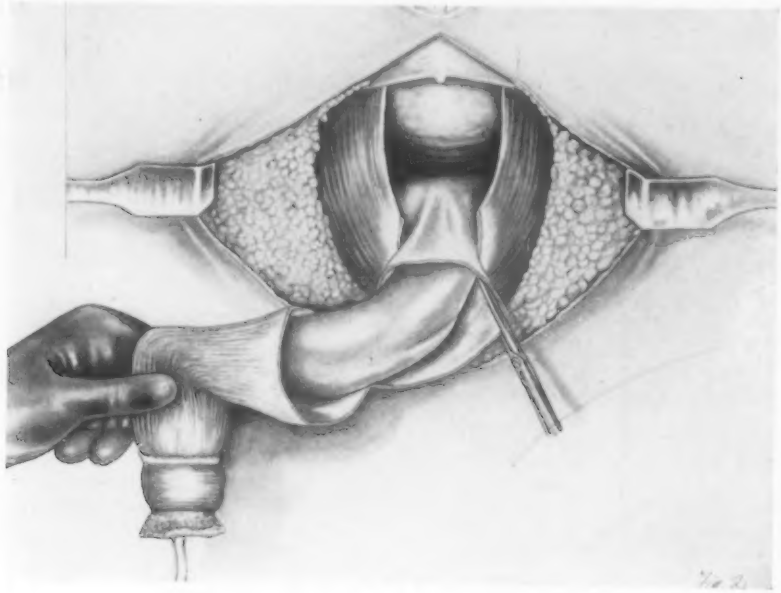


FIG. 2.

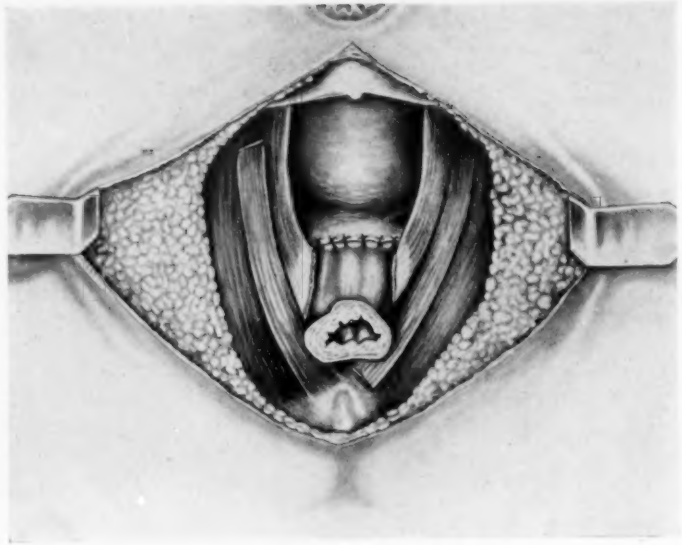


FIG. 3.

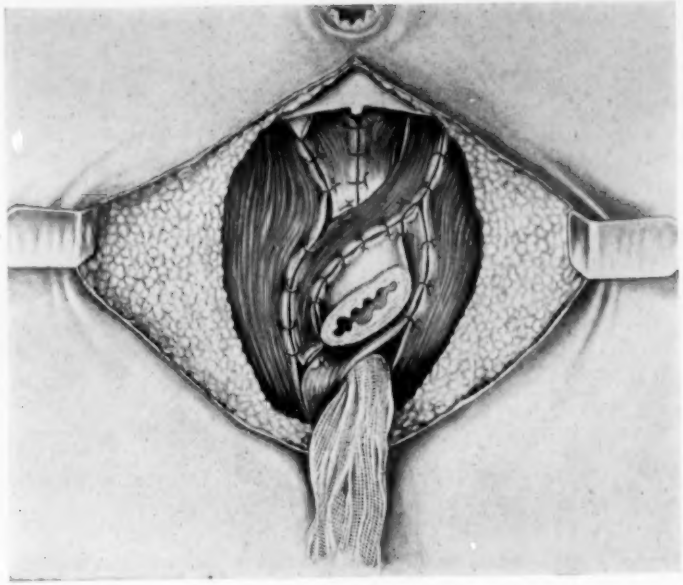


FIG. 4.

FIG. 5.

three days, but the discharge continued until the end. There was a very offensive odor."

It seems fair to assume that this is the story of the recurrence of a rectal carcinoma eight years after operation with death from intestinal obstruction two years later. Another instance of the necessity of following carcinoma for many years before cures can be reported.

CASE II.—Mrs. K. O., aged twenty-eight years, housewife. For three months has noticed slight bleeding and some pain occurring with bowel movements. There has been no change in size or shape of the stool, and so far as she knows there has been no change in her general health. Has not noticed any offensive odor. The bleeding has increased slightly. Has lost little, if any, flesh. Appetite good. Sleeps well. Bowels are constipated.

Physical Examination.—The patient is a thin, wiry woman, but fairly well nourished. Physical examination fails to reveal any abnormality save the local condition.

Rectal Examination (Digital).—Shows an irregularly rounded, hard ulcer with everted hard edges in the anterior wall of the rectum. It is movable on the vaginal wall and the entire rectum is movable. No glandular enlargement can be felt. The ulcer is approximately 1 inch by 1½ inches in size and the examining finger can be passed beyond its upper border.

Operation was performed in June, 1917. Apparently the growth was resected as completely as in the preceding case. The glands in the hollow of the sacrum did not feel enlarged and nothing could be felt above. The operation was performed according to the technic outlined, the lower 6 inches of the rectum removed, and the plastic operation on the levator ani muscles performed. Convalescence was uneventful and the patient was allowed up at the end of twelve days. Bowels were moved by enema and thereafter the patient had control of her bowel movements.

The report of Dr. J. E. MacWhorter, pathologist to the First Surgical Division of Bellevue Hospital, stated that the growth was an extremely virulent carcinoma with microscopic infiltration of all the tissue, even up to the point of removal. This could not be determined by macroscopic examination of the specimen which at the time of operation was presumed to be no more malignant than that of the previous case.

The patient returned every two weeks for examination and for three months did well. The bowels functioned normally and without loss of control. At the end of that time a recurrence occurred at the new anal orifice which rapidly increased in size and caused a stricture of the anus. At approximately the same time the patient complained of gastric symptoms and pain in the chest with dyspnœa. X-ray examination gave findings of pyloric obstruction with a doubtful shadow in the mediastinum.

The patient was again admitted to the hospital and as symptoms of chronic intestinal obstruction had appeared a left inguinal colostomy was performed. At this operation the left ovary was found

markedly enlarged, hard, and of a peculiar translucent appearance, so it was removed and upon examination proved to be a Krunkenberg tumor of the ovary.

The patient gradually failed and died less than six months after the primary operation. An autopsy was refused, so definite information as to the condition of the stomach and thorax could not be obtained. It seems fair to assume, because of the close association between carcinoma of the upper intestinal tract and the ovarian tumor first described by Krunkenberg as primary in the ovary, that the gastric condition was probably a carcinoma secondary to that in the rectum. There was no evidence of gastric involvement previous to the rectal operation and all the indications are that the rectal tumor was the primary growth. From examination of the microscopic sections it is not probable that this patient could have been saved by a combined operation. All of the perirectal tissues were invaded in every direction, though nothing could be seen or felt macroscopically—and there is no doubt that the growth had progressed beyond any possible hope of removal.

By the operation above described the lower 6 inches of the rectum can be removed by the perineal route and a new sphincter which will function can be formed from the levator ani muscles. Cases of carcinoma suitable for operation by this route can be relieved with less danger to life than by the combined operation, and subsequently live in comparative comfort.

TECHNIC OF PARTIAL COLECTOMY BY THE MIKULICZ TWO-STAGE METHOD

By Charles N. Dowd, M.D.
of New York, N. Y.
surgeon to the roosevelt hospital

In the Annals of Surgery for February, 1920, the writer published an article on "The Advantages of the Mikulicz Two-stage Operation of Partial Colectomy." The references to this article have been mainly of two varieties: one, communications from a number of experienced sur-

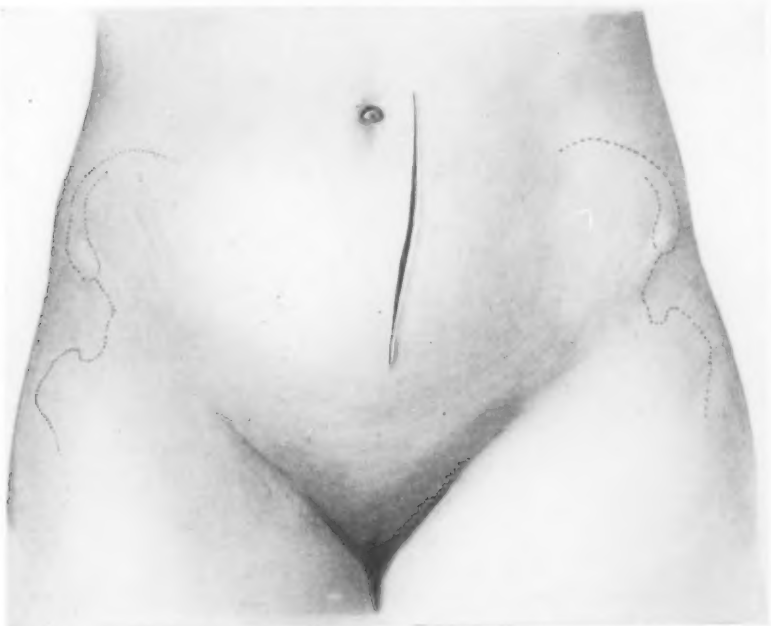


Fig. 1.—Primary incision. Used for exploration, mobilization of intestine and for removal or mobilization of enlarged lymphatics.

geons acknowledging the advantages of the principle of "exteriorizing" the growth before the intestine is opened; the other, requests for information about various details of operative technic.

There have been so many inquiries of the latter type that it seems advisable to publish a further description of this technic by giving the details of a single illustrative case of partial colectomy for cancer at the sigmoid. This is done in the hope of further popularizing an operation which diminishes the dangers of patients with cancers of the large intestine between the hepatic flexure and the lower sigmoid or with other lesions which call for partial colectomy in this region.

In the previous article, sixteen cases of partial colectomy were reported, with one death. Since that time the writer has successfully operated upon three additional cases; one for cancer of the transverse colon, one for Hirschsprung's disease, and one for cancer of the sigmoid. This low mortality rate in a short series of cases indicates the comparative safety of the procedure, but it should not mislead the reader. Individual operators continually have short series of cases which give better results than can be maintained in long series.

History of Patient.—Mrs. D. C., a rather thin woman, aged thirty-two years, came to the Roosevelt Hospital March 13, 1920, suffering from long-continued intestinal obstruction.

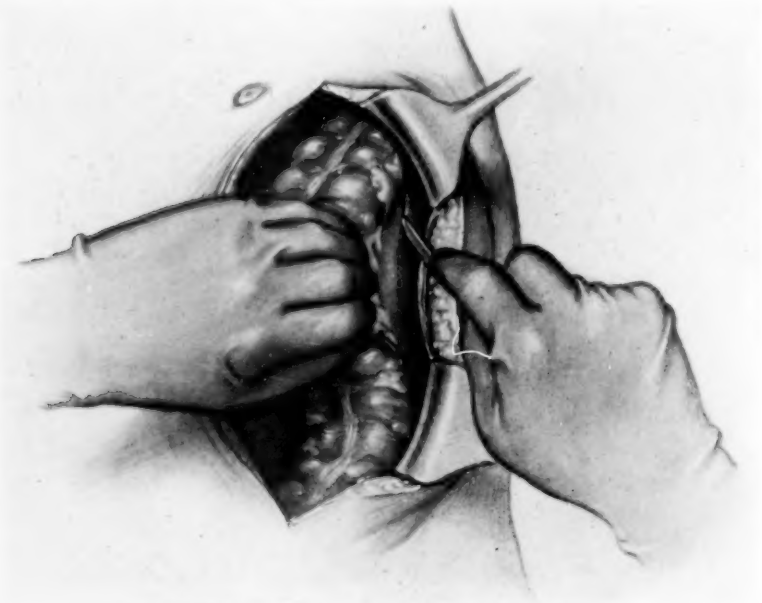


FIG. 2.—Incision of outer leaf of peritoneum beside descending colon so as to secure suitable mobility of that part of colon.

She stated that she had been in excellent health until two months ago when she had cramp-like pains across the abdomen, especially in the lower left side. These were severe and were accompanied by constipation. She went for two weeks with very slight fecal passage. Large quantities of fæces then passed and she was relieved. For more than two weeks she then had suitable bowel movements.

On admission she stated that the last bowel movement had occurred twenty-six days ago. During that time she had eaten very little, but had taken various forms of broth. She had suffered much from abdominal pain, but had vomited very little, excepting after taking castor oil. Occasionally the return from the enemas had been blood-tinged. Just before coming to the hospital severe

vomiting had begun and hence she sought immediate relief. She was in reasonably good general condition. Heart and lungs, sound; abdomen distended; visible peristalsis; no tumor palpable either by examination or by rectum.

Description of Operation.—The details of the operation for this patient are shown in the accompanying plates. They give a fair indication of the average procedure.

1. *Primary Incision.*—A low, five- or six-inch incision, near the median line, gives opportunity for suitably exploring the abdomen,

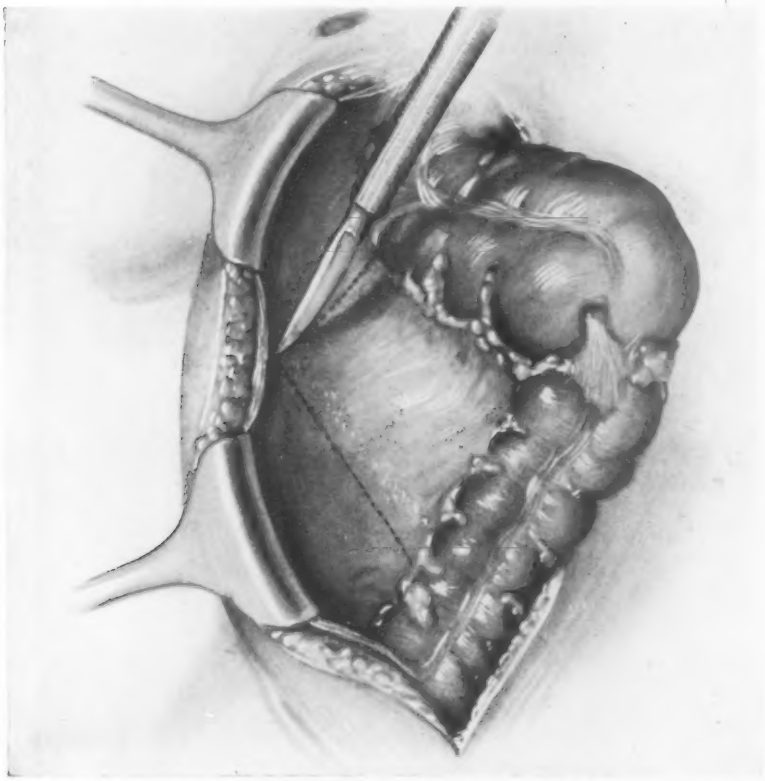


FIG. 3.—Exposure and removal or mobilization of enlarged lymphatics and part of meso-sigmoid.

learning the site and character of the primary lesion, and searching for metastases and lymphatic enlargement. With or without enlargement, it also permits the mobilization of the growth in operable cases. Figs. 2, 3, and 4 indicate the portion of work which was done through this incision in this case.

2. *The incision of the outer leaf of the peritoneum of the descending colon,* as advocated by Moynihan and others and as indicated in Fig. 2, is easily accomplished and secures wonderful mobility of the corresponding portion of the intestine. When carried upward sufficiently, it permits the mobilization of the splenic flexure.

3. *Removal of Lymphatics.*—It is desirable to examine the lymphatic areas which are liable to infection. Jameson and Dobson[1] have carefully investigated the anatomy of these areas. It is not always practicable to completely remove them, nor is it always necessary. Numerous observers have shown that cancer of the colon may long remain a local disease. Clogg[2] made post-mortem examinations in eighteen patients with cancer of the pelvic colon. Enlarged lymph-nodes were noted in seventeen instances, but only

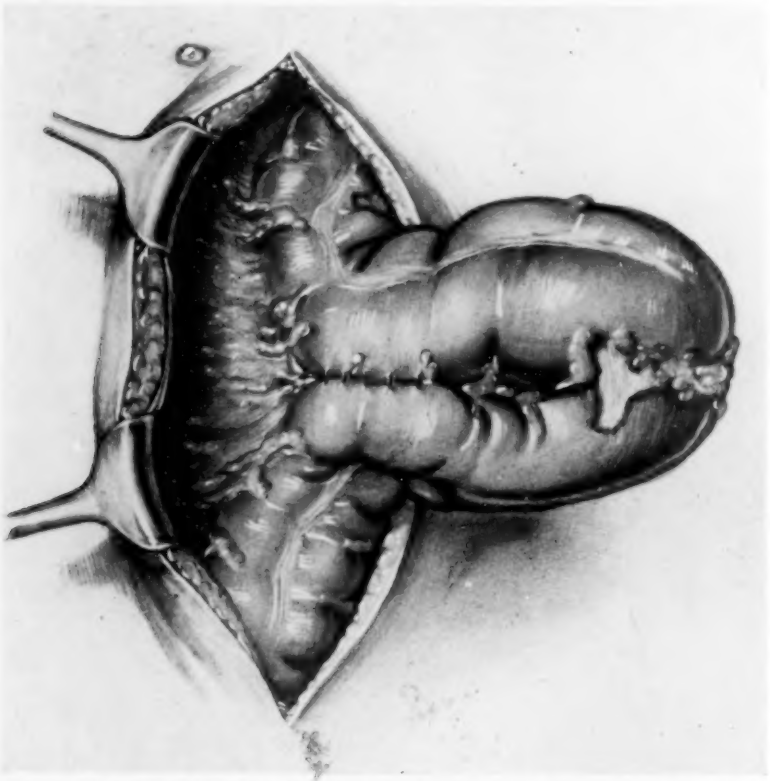


FIG. 4.—Stitching of afferent and efferent legs of intestine so as to form a septum which is suitable for later clamping.

in six were they at a distance from the colon. He found that enlarged lymph-nodes did not show cancer cells in one-third of the cases examined. The judgment of the individual surgeon must determine the extent of the lymphatic area which is to be removed.

In this instance the small intestines were retracted to the right and the mesocolon was exposed as far as the spine, the peritoneum was incised, and the lymph-nodes were mobilized and either removed at once or pushed toward the sigmoid. Branches of the left colic and inferior mesenteric arteries were clamped, tied, and cut, but the

[1] Proceedings of Royal Society of Medicine, 23, 1908–1909, Surgical Section, p. 149.
[2] H. S. Clogg: Cancer of the Colon. Lancet, 1908, vol. ii, p. 1007.

main trunks of both of these arteries were preserved. A sector of the peritoneum, with apex at inferior mesenteric artery and base at the sigmoid, together with the adjacent lymphatics, was mobilized

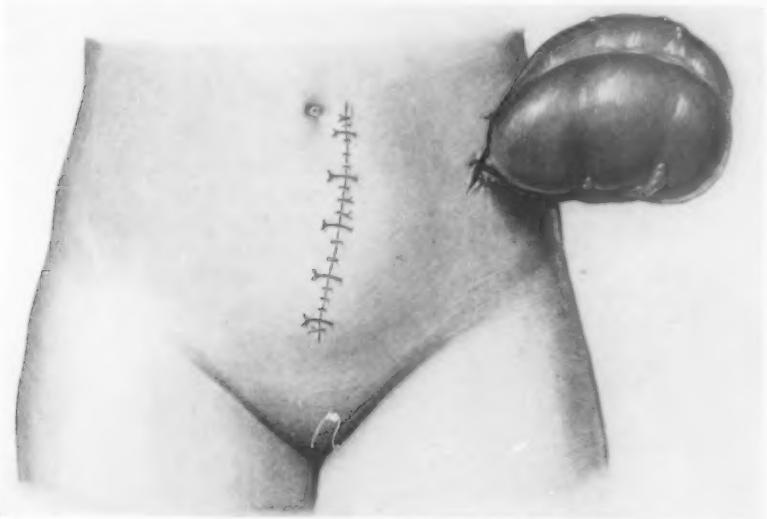


FIG. 5.—Primary wound closed. Diseased intestine delivered through small secondary intramuscular wound. (In this instance it was distended by pressure of gas from above.)

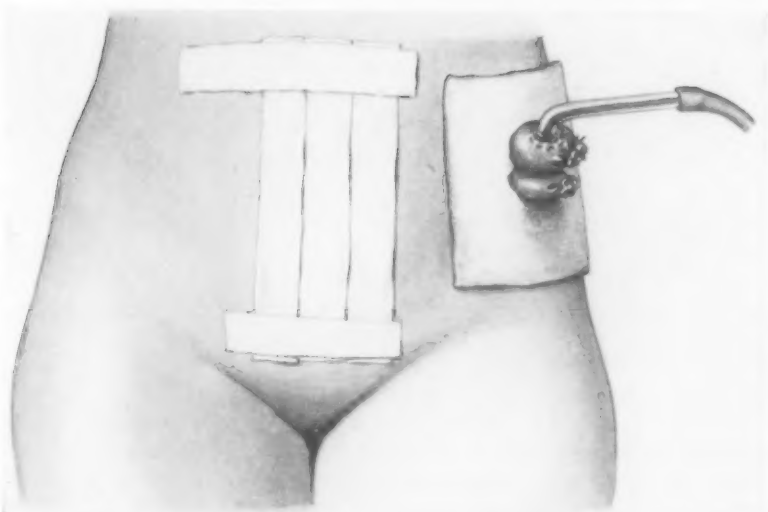


FIG. 6.—Primary wound covered by aseptic dressing. Secondary wound smeared with ointment and protected by gauze. Protruding parts of afferent and efferent intestine ligated. Diseased portion of intestine ablated. Paul's tube inserted in protruding part of afferent intestine so as to secure and temporarily control drainage.

and pushed to the sigmoid. The breadth of this sector must vary somewhat with the individual case. Since the lymphatics extend along the intestinal wall to the next afferent arterial branch, it is desirable to remove a corresponding portion of the intestine, with its ad-

jacent arterial loops, and the incision in the mesosigmoid should be large enough to permit this.

The real point at issue is that in the two-stage operation the extent of lymphatic dissection and the length of the removed portion of intestine may be as great as in the one-stage anastomosis. Tension is to be avoided in any instance, but the danger of moderate tension is not so great in the two-stage procedure as in the one-stage procedure. Unless the abdominal wall is unusually thick, patients who give suitable facilities for one-stage anastomosis are likely to give equally good opportunity for two-stage procedure.

FIG. 7.—Clamp for dividing the "spur" by pressure. At first the pressure was secured by a rubber band applied to the handles; afterward the ratchet is used for progressive tightening of the clamp.

4. *Stitching of Afferent and Efferent Legs of Intestine so as to Secure a Good "Spur."*—Sound portions of the afferent and efferent legs of intestine were selected at safe distance from the cancer and stitched together with fine catgut for a distance of two inches or more. This secured suitable apposition between these portions of intestine. A good septum was thus formed to which a clamp was safely applied at a later time.

5. *Exteriorization of Cancerous Portion of Colon.*—This is best accomplished through a small separate incision at a convenient site. In this instance finger pressure was made from within the abdomen a little above and internal to the anterior superior spine of the ilium and a small intramuscular incision of the McBurney type was made there. The diseased loop of intestine was then drawn through this incision. In this instance there was so much gas pressure from above that the extruded intestine "ballooned up" like an inflated rubber bag. The edges of the skin were stitched to the intestinal wall.

The primary incision was then closed in layers and covered with a small, sterile, gauze dressing. This in turn was completely covered in with strips of adhesive plaster which extended onto the surrounding skin. In this way healing of the primary wound by first intention was secured.

The small size of the new incision and the undisturbed condition of the tissues about it leave little likelihood of mural abscess about the stoma.

6. *Treatment of Excluded Portion of Colon.*—After the skin and adjacent portion of colon have been well smeared with a 10 per cent. boric acid ointment, gauze is laid about them.

We now have the abdomen shut off. Since the intestine has not been opened, there has been little likelihood of infection. In

Mikulicz' early cases the loop of cancerous intestine was permitted to slough in the dressing. This, however, was not done in his later cases and is unnecessary. A ligature can be placed about each loop of intestine outside the gauze dressing. The cancerous loop of gut can be ablated. The time for opening the protruding intestine depends upon the condition of the patient. In some instances it may be deferred for forty-eight or even seventy-two hours. In this instance, owing to the pressure of gas from above, an immediate opening was desirable, therefore a purse-string was placed in the upper leg of intestine between the ligature and the gauze dressing, a Paul's tube was inserted and held fast by a tightening of the purse-string. This permitted gas and fæces to escape without soiling the

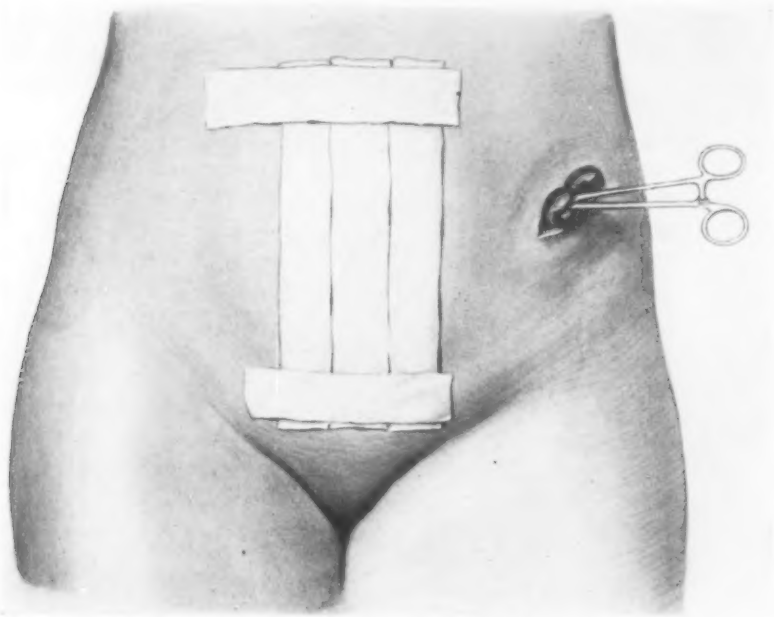


FIG. 8.—Clamp applied to septum.

dressing. The purse-string joint held for twenty-four hours, which was sufficient to permit a reasonably good union between the abdominal wall and the intestine and thus prevent infection at that point.

7 and 8. *Clamping of the Spur.*—The ligatures about the ends of the intestine were removed after forty-eight hours. A "double-barrelled" intestinal stoma was thus established which provided an exit for the intestinal contents. After nine days the union of the abdominal wall was firm. There was no evidence of surrounding inflammation there and the crushing of the spur between the two legs of intestine was begun. Various clamps have been used for this purpose. The one which bears the name of Mikulicz is believed to be a very efficient one. We have tried various forms of clamps and, at the present time, use an ordinary Kocher clamp (Fig. 7), or a

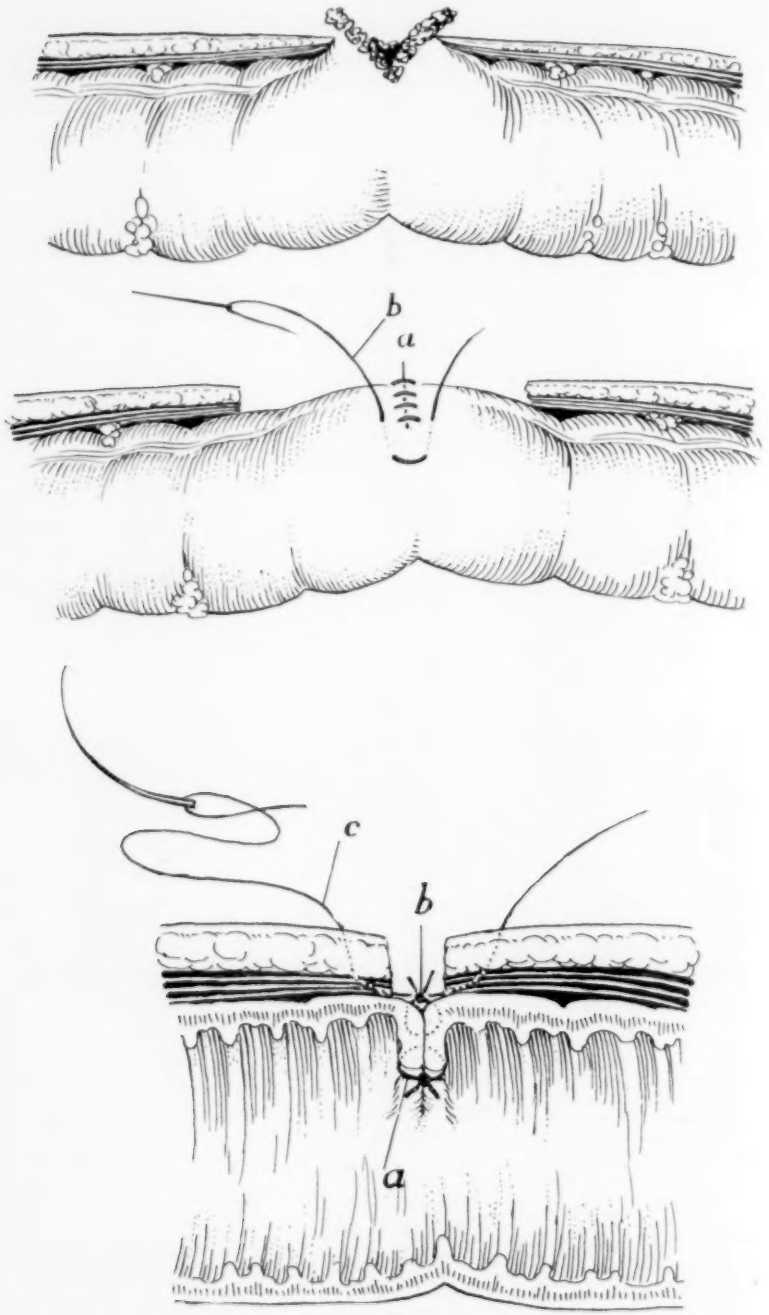


FIG. 9.—Closure of stoma. The intestine is separated from its attachment to the abdominal wall so as to expose its peritoneal surface. The lower leg is then pulled upward and the upper leg downward. Interrupted chromicized gut stitches (*a*) are taken through the entire intestinal wall at the upper and lower edges of the stoma and tied with their knots inside the intestinal lumen. This row is then reinforced by Lembert stitches (*b*). The edges of the abdominal wall are then approximated by silkworm-gut stitches (*c*), leaving provision for possible leakage.

similar clamp without teeth at its end. After inserting fingers on each side of the septum so as to determine the relationship of the parts, the clamp is applied and an elastic band applied about the handle so as to make firm pressure. At the end of one or two days the first notch of the ratchet was fastened. On successive days, additional pressure was applied (Fig. 8) and the clamp came away on the fifth day. In this instance the artificial anus discharged intestinal contents regularly and the mouth of the stoma contracted moderately.

9. *Closure of Stoma.*—On the twenty-fifth day an effort was made to close the stoma. The skin was dissected away from the margin of the intestine. The upper leg was pulled downward from above (Fig. 9) and the lower leg was pulled upward from below, thus securing enough intestine for good serous apposition of the ends. The peritoneum was slightly opened for this procedure, and the edges of the peritoneal opening were easily secured by a few catgut stitches. The first row of stitches was then taken between the intestinal ends. They were interrupted, chromic gut included the entire intestinal wall, and the knots were tied inside the lumen. A second row of Lembert stitches of chromic gut was then taken to secure apposition outside of the first row. The edges of the abdominal wound were then drawn together with silkworm gut, leaving a very small opening for the escape of leakage. In this instance the closure was not complete and after two weeks a clamp was applied to a portion of the spur which remained. After this clamp came away the stoma was again closed by two rows of stitches and the suture line was supported by loose, silkworm gut stitching through the overlying abdominal wall. The wound then closed satisfactorily and the patient left the hospital May 26th. The period of her operation and after-treatment was, therefore, ten and five-sevenths weeks. This was longer than a successful one-stage operation would have taken. A one-stage operation, however, was not to be considered for this case. The intestine was too greatly distended and contained too much foul fecal material. A preliminary colostomy and later one-stage operation would probably have taken longer and would have been much more dangerous.

PRIMARY CARCINOMA OF THE VERMIFORM APPENDIX IN SISTERS SUFFERING FROM TUBERCULOSIS*

By Alexander Primrose, C.B., M.B., C.M., Edin.
of Toronto, Canada
Professor of Clinical Surgery in the University of Toronto

The ileocæcal region in man's anatomy is of great interest not only to the surgeon who, in recent years, operates more frequently for disease of the appendix than for trouble in any other part of the body, but also for the morphologist and physiologist. Huntington in his delightful book on "The Anatomy of the Human Peritoneum and Abdominal Cavity" presents a wealth of material in his study of the comparative anatomy and embryology of this region and its phylogenetic significance. He refers to the human vermiform appendix as a rudimentary and vestigial structure, and with this view most authorities agree. On the other hand, Keith in his book on "Human Embryology and Morphology" presents a different view. He tells us that "in all vertebrates the submucous coat of the cæcal colon is rich in lymphocytes which in mammals collect in the form of solitary follicles more or less closely crowded together. In primates Berry found a tendency for the lymphoid tissue to be aggregated in the apex of the cæcum. In man, in anthropoids and a few other forms, the lymphoid tissue becomes richly developed in the distal part of the cæcum, which has a narrow lumen, strong muscular coat, and is of great functional activity during digestion. This highly specialized part of the cæcum is the appendix; it is well developed in man and is certainly not a vestigial structure." Berry described the appendix as a lymphoid diverticulum of the cæcal apex, and Keith insists that it must be regarded as a lymphoid structure, and although it can be dispensed with, is not, therefore, to be regarded as vestigial in nature any more than the tonsil. I present this view because there has been a tendency to account for the occurrence of carcinoma in the appendix by considering it as a vestigial organ. Thus Elting favors this theory, endeavoring to explain the occurrence of cancer in this region, by stating that fetal remains as well as atrophying organs appear to be more prone to the development of carcinoma.

Primary carcinoma of the appendix is now a recognized entity. Boyer recently reviewed 300 cases from the literature. In spite of the fact that many observations have been made, we are still in the dark as to its nature and true significance. We find reference to it as a "benign carcinoma," a new term in medical literature, and yet perhaps justified by

* Read before the Alumni Association, Medical Department, University of Buffalo, June 10, 1920.

the course run in nearly all the cases recorded. As a rule, there is nothing to lead to a diagnosis of cancer by the gross appearance, and it is only because of the histological picture that we classify our cases as such. In recent years a routine histological examination of all tissue removed at operation is carried out in every properly-organized surgical clinic. As a result we have made many discoveries of conditions hitherto unsuspected, among others the occurrence of primary cancer in the appendix. When we depended largely on observation of gross anatomy such tumors were no doubt overlooked. Zaaijer quotes an observation of Roger Williams made in 1893 to the effect that, "In an examination of the records of 15,481 neoplasms, met with at St. Bartholomew's, Middlesex, University College and St. Thomas Hospitals, he could find no mention of any neoplasms involving the vermiform appendix." As a matter of fact, in nearly all the cases of primary carcinoma of the appendix on record there was no evidence of malignancy in the gross appearances and evidence of cancer was only demonstrated by microscopic examination. The tumor when found at operation is usually small in size, varying from that of a pea to a pigeon's egg; it presents a smooth, regular surface, and rarely shows any tendency to the formation of metastases. It is usually situated at or near the tip of the appendix. In one of my cases it was at the distal end and in the other at the extreme proximal end. In many instances there is no gross tumor and the condition is only recognized on opening the appendix or in the examination of appendices which have been the seat of an inflammation causing obliteration of the lumen with the formation of scar tissue. In certain rare exceptions, however, the evidences of malignancy are present, both gross and microscopic.

My object in reporting two cases of primary carcinoma of the appendix is because they occurred in sisters, both of whom suffered from tuberculosis. In one case the patient had pulmonary tuberculosis and the other had primary tuberculosis of the Fallopian tubes. Both patients made good recoveries from the operations performed. The histories of these cases are as follows:

Case I.—M. H., female, aged twenty-one years. Admitted to hospital June 20, 1919, with symptoms of acute appendicitis; she had a history of pain and vomiting and on admission had a temperature of 101° F. She had had two previous attacks. She was operated upon the same day. The appendix was swollen and congested and tied down in an acute kink by firm scar tissue. At the base of the appendix was a hard, smooth nodule the size of a small pea. It was so close to the cæcum that I had to remove part of the cæcal wall in order to cut wide of the tumor. The tumor, however, was confined to the appendix and did not involve the cæcum. The uterus, ovaries, and Fallopian tubes were examined and found normal. Subsequent to operation she showed a persistent high evening temperature, and on examining the chest evidence of congestion was

found in the right lung; 10 c.c. of clear straw-colored fluid, withdrawn from the pleural cavity, was found to be sterile. A diagnosis of pulmonary tuberculosis was subsequently made, and she was transferred on July 12th to a sanitarium.

The report of the histology of the tumor found at the base of the appendix was made by Dr. W. L. Robinson as follows (Fig. 1):

> The lumen, mucosa and part of the submucosa are replaced by a tumor growth made up of large cells which are more or less spherical in shape.
>
> The nuclei are large, oval-shaped and hyperchromatic, a few of which are undergoing mitoses. These cells show a marked tendency to an alveolar arrangement. In the centre of the growth the cells are grouped in large masses, with very little stroma. Towards the periphery they are squeezed out into cords and are associated with a great deal of fibrous-tissue stroma. They are also infiltrating the muscle layers, and again appear in the subperitoneal coat as large masses, with a small amount of stroma. There are a few lymph follicles still in the submucosa. Another section of the appendix shows the lumen to be completely obliterated with fibrous tissue infiltrated with a large number of lymphocytes, and also containing a few small masses of epithelial cells similar to those described above.

Case II.—I. H., female, aged twenty-nine years. Admitted to hospital February 14, 1920. Five or six years previously, while a nurse in training, she suffered from continued abdominal distress and was laid up for eight or ten weeks. During this time she was examined under anæsthesia and is said to have had "Endometritis." About a week before admission she developed abdominal pain which was more or less continued and persistent. On digital examination, by the rectum, pain was produced on pressure such as might be accounted for by an inflamed appendix lying low in the pelvis. The temperature did not arise above 99° F., but her blood showed a white-cell count of 19,000 per cubic mm. An operation was performed on February 17, 1920. Through a right rectus incision I was able to inspect the gall-bladder which was small, normal in appearance, and free from adhesions. The cæcum was pendulous and lay, along with the appendix, in the pelvis. The appendix was firmly adherent: it was separated from its adhesions and removed. The tip of the appendix was converted into a hard nodule, oval in shape, with a smooth surface and in bulk about twice the size of a pea. I at once remarked upon the fact that it resembled closely the nodule found in the appendix of her sister, which I had removed eight months previously, and suggested, from the gross appearance, that we again had primary carcinoma of the appendix. On exploring the pelvis I found the uterus drawn well to the left and bound down to a mass which existed in the left broad ligament. In this mass one was unable to distinguish tube or ovary until I had separated the adhesions along natural lines of cleavage: in doing so a small particle of caseous material, about the size of a grain of rice, escaped. The suggestion was made that the deeply-congested Fallopian tube, which we thus isolated, was tuberculous. The tube was removed, but not the ovary. One found similar conditions in the right broad ligament,

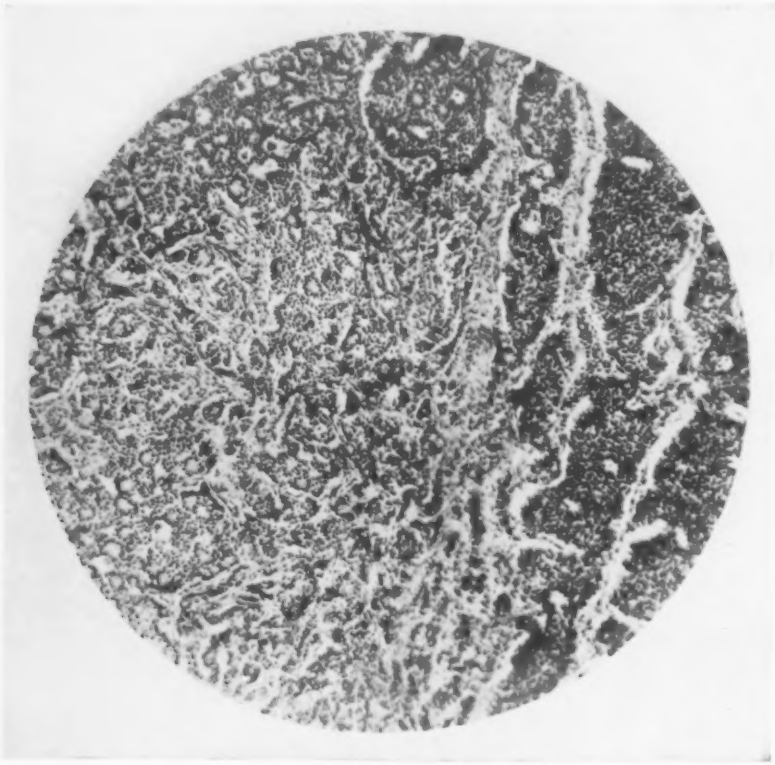


FIG. 1.—x150. Section of appendix in case No. 1, showing the growth of cells with marked tendency to alveolar arrangement.

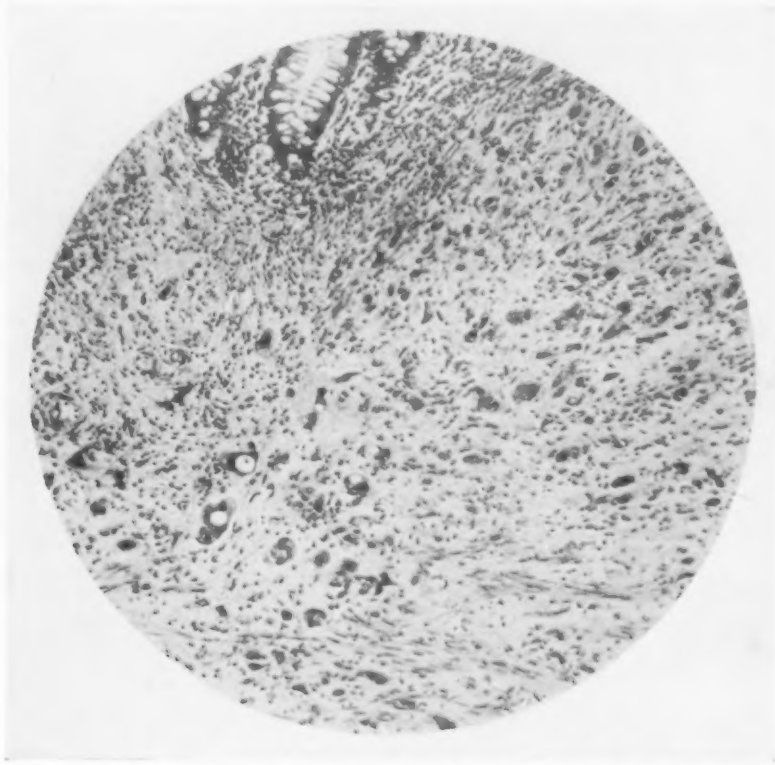


FIG. 2.—x150. Section of wall of the appendix in case No. 2, showing the cords of epithelial cells with fibrous tissue stroma.

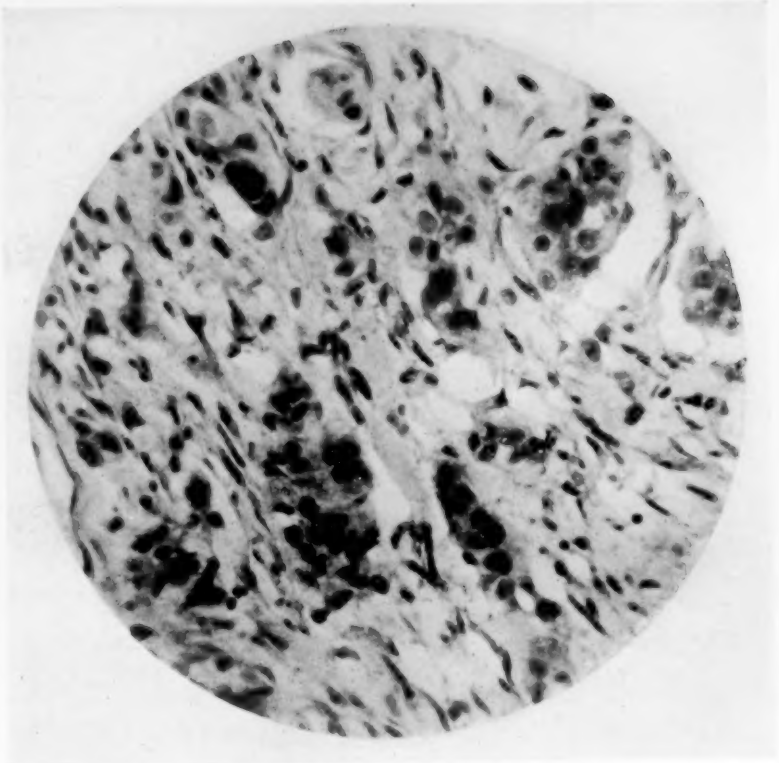


FIG. 3.—x800. Section of wall of the appendix in case No. 2 more highly magnified to show columns of epithelial cells and fibrous tissue stroma.

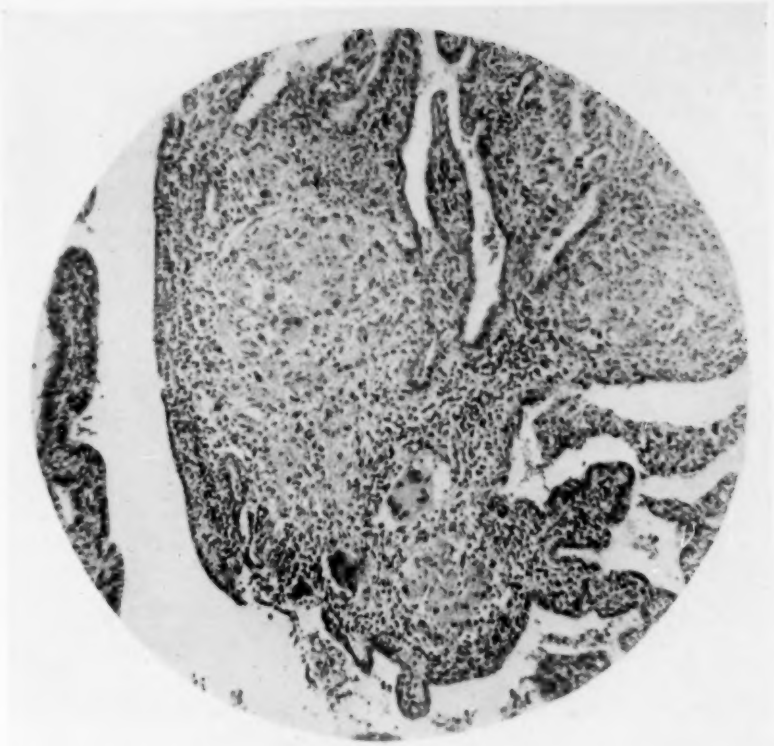


FIG. 4.—Section of the fallopian tube in the case No. 2, showing typical tubercles with areas of endothelial cells and giant-cells.

but the ovary was so involved in the process I removed both tube and ovary in one mass. There was no evidence of tubercle on the serosa or in lymph-glands.

Doctor Robinson's report on the histology of the tumor of the appendix and of the Fallopian tube is as follows (Figs. 2, 3, and 4).

Microscopic Report on Appendix.—The tumor growth is made up of solid cords of epithelial cells, with a considerable amount of a dense fibrous-tissue stroma. A few small masses of these cells can be seen in the mucosa, apparently extending from it and infiltrating the submucosa and muscle coats and growing out into the peritoneum. The epithelial cells are very irregular in size and shape. The nuclei are hyperchromatic. Many cells are very large and multinucleated. There are a few mitotic figures present. The mucous membrane of the appendix is intact and apparently normal apart from the tumor cells present.

Fallopian Tube.—The wall of the tube shows an increase of fibrous tissue, with a slight diffuse lymphocytic infiltration. Scattered through the mucous membrane are a large number of areas of endothelial cells, with giant-cells forming typical tubercles, some of which show a slight amount of caseation in the centre.

There are apparently two main types of so-called primary carcinoma of the appendix. In one type the histological picture shows numerous nests of small spherical or polygonal cells with a considerable development of interstitial connective tissue surrounding the individual cell nests. The marked degree of fibrosis which exists in these cases is worthy of note. The second type consists of cylindrical or columnar cells presenting an adenoid structure and comparable in its histological structure to the adeno-carcinoma found in other parts of the intestine. In both instances the tumor growth may be confined to the submucosa or may infiltrate the muscular coat and extend to the serous coat. In some instances the serosa has been penetrated and neighboring coils of intestine have been implicated. Colloid cancer has also been described, one such was reported by Elting in a man eighty-one years of age.

The frequency of occurrence in appendices removed at operation or examined at autopsy indicates that it may be looked for in about 0.4 per cent. (MacCarty, .44 per cent. in 8039 specimens; McWilliams, 0.4 per cent. in 6505 specimens.) The age of the individual indicates its occurrence at an earlier age than is usual for intestinal carcinoma: in 300 cases reported by Boyer most of the cases occurred between the ages of twenty and forty years; the youngest patient reported was five years of age, the oldest eighty-one; some interesting facts are brought out by McWilliams in his analysis of 90 cases: the spheroidal-cell cancers are 30 per cent. more frequent than the columnar type, and moreover, the average age for the spheroidal type was twenty-three years and for the columnar type forty-three years. In the small intestine and large intestine adeno-carcinoma occurs in almost three-fourths of all cases, while in the appendix adeno-carcinoma constitutes only about one-fourth of the cases. Again, accord-

ing to McWilliams' statistics, if the stomach and intestines are considered together, the spheroidal-cell type of cancer occurs in only one-fifth of the cases, while they constitute three-fourths of the cases occurring in the appendix.

It would appear that from 60 to 70 per cent. of the cases are in females (Boyer). Reiman places the percentage in females as high as 65 to 75 per cent. This finding may in part be accounted for by the fact that the appendix is so frequently removed during gynæcological operations, coupled with the further fact that practically all cases of carcinoma of the appendix are discovered accidentally. Child has called attention to disease of the pelvic organs in women as an important exciting cause of appendicitis. In one of my cases there was a double tuberculous salpingitis with the carcinomatous appendix adherent to the mass in the right side of the pelvis.

A striking characteristic in these tumors is the fact that they are benign. There is no recorded instance of recurrence after removal. Metastasis is a very rare event. LeConte and Elting each describe a case with metastasis in the ileocolic lymph-glands. In only one case out of ninety in McWilliams' series was there positive demonstration of metastasis in lymph-glands. Oberndorfer reports two cases with metastasis. Local malignancy, as evidence by infiltration by the primary growth of structures beyond the appendix, is recorded in a few instances (Ross, LeConte, Coley, Elting, and Neugebauer). Batzdorff states that the disease extends beyond the appendix in 6 per cent. of the cases recorded.

All observers have recognized the association of primary cancer of the appendix with a chronic inflammation which usually leads to an obliteration of the lumen by a process of fibrosis. The etiological relationship between chronic inflammation and cancer in the appendix has been emphasized by Mayo. This was apparent in the cases recorded by the writer. Moreover, the tumor possesses a fibrous tissue stroma which is usually dense and considerable in amount. So marked is this characteristic that some authorities refer to the tumor as a scirrhous cancer (Adami and McCrae), and indeed, the histological picture in one of my cases closely resembled that of a scirrhous cancer of the breast.

Brewer narrates a case of carcinoma of the appendix in which a careful study of the specimen revealed the fact that it occurred at the site of a healed perforation, and in that perforation a little curtain of mucous membrane prolapsed through the opening. Healing had taken place and the epithelial cells of the mucous membrane were embedded in the tissue: this suggests for some cases a possible etiological factor in the displaced epithelial cells.

There is still some confusion in the attempt to determine the true nature of this interesting tumor. Aschoff compares it to tumors of somewhat similar character occurring in the small intestine first described by Lubarsch. Adami and McCrae call attention to the fact that the rare carcinomas of the lower end of the ileum are of the same benign type.

Aschoff and Mallory note the resemblance of the histological structure to the epithelial formation which occurs in connection with nævi in the skin, and the suggestion is that they should be regarded as analogous to such congenital anomalies. The cells resemble somewhat the basal cells of cutis tumors. Then there is a tendency to regard the cells, at all events those of the spheroidal type, as endothelium: Glazebrook reported a case in 1895 which he called "endothelial sarcoma of the appendix" (quoted by Elting). Ewing states that in some cases "the structure resembles that of endothelioma arising from the lymph-spaces of inflammatory connective tissue." Oberndorfer, in discussing Winkler's paper before the Deutschen Pathologischen Gesellschaft, 1910, described the spheroidal type as a growth of lymph-vascular endothelium and not a cancer. Milner also speaks of this type as a product of an inflammatory growth chiefly of the adenoid tissue of the mucosa and the lymph-vascular endothelium.

Whatever be the genesis of this interesting tumor one fact is established, namely, its association with a chronic inflammatory process. We wish, however, in this communication to emphasize its relation to tuberculosis. It is remarkable in reviewing the literature to note how frequently this association exists. In individual cases reported we find tuberculosis mentioned as an accompaniment, *e.g.*, by Lubarsch, Kelly, Letulle and Weinberg, Winkler, and others. Each of the two cases reported in the present paper exhibited tuberculous lesions. This relationship between tuberculosis and cancer is not commonly commented upon. It is conceivable, as Lubarsch points out, that tuberculous infection can, even as a local trauma, lead to the development of carcinoma. Milner, writing in 1910, in the investigation of fourteen cases of what he calls "pseudo-carcinoma" of the appendix, speaks of these tumors as reminding one of what is seen in tuberculous cases, and concludes that "the tumors are the product of a chronic hyperplastic inflammation, chiefly a hyperplastic lymphangitis, and their parenchymal cells are endothelium and not epithelium."

Tuberculous invasion of the Fallopian tube may simulate carcinoma in its histological picture: thus Barbour and Watson in studying tuberculous pyosalpinx found that while the tubercle nodules were confined to the mucous membrane, there had been a hypertrophy of the epithelium which penetrated deeply into the muscular layer together with the formation of strands and masses of epithelial cells in the substance of the mucosa. This produced "an appearance very like carcinoma." Further at the extreme ends of the tubes they found the mucous membrane free from tubercles, but there existed marked hyperplasia of the epithelial covering and a deeper extension into the muscular wall. Embedded in the muscle were gland-like spaces lined by epithelium at a considerable distance from the lumen. The condition found by these authors in the Fallopian tube, infected by tubercle, bears a striking resemblance to the histological characteristics of the so-called primary carcinoma of the appendix.

The ileocæcal region is frequently the seat of tuberculosis. It is common experience to find evidence of healed tuberculosis when operating for appendicitis, the ileocolic lymph-glands are not infrequently enlarged and caseous. Fenwick and Dodwell (quoted by Kelly) in 2000 autopsies of persons dying from tuberculosis found that the intestinal lesion was limited to the appendix in seventeen cases. Further, the appendix is often invaded by tuberculosis through direct contact with a tubercular tube or ovary. Kelly reports four such cases in his own experience. The striking feature exhibited in Case II, recorded in the present paper, was the remarkable combination of an appendix, the seat of a primary carcinoma, being adherent to a tube, the seat of primary tuberculosis.

The writer does not feel competent to enter into a controversy as to the nature of the cell growth in these tumors, but in view of the doubt which obviously exists at present as to their true nature he would urge from the clinical side that tuberculosis is too frequently an accompaniment to be a mere coincidence and must be of some significance. Furthermore, it becomes obvious that many authorities regard these cells as endothelial: this, together with the marked tendency to fibrosis, cannot but remind one of the characteristic features noted in the development of tubercle.

In conclusion one may call attention to heredity as an etiological factor. Harte reports a case in a patient forty-one years of age whose mother suffered from advanced scirrhus of the breast; this may have been a mere coincidence, but the interesting feature in my cases is that in addition to the double history of tuberculosis my two patients were sisters. As far as I am aware, this is the first time that members of the same family are reported to have suffered from primary carcinoma of the appendix; yet, hitherto, the number of cases reported are comparatively few in number, and it might well be that this specific instance may point to heredity as a factor, both in the production of the tuberculosis and of the tumor growth, with possibly some connecting link between the two pathological conditions exhibited.

BIBLIOGRAPHY

Adami, J. G., and McCrae: A Text-book of Pathology, 1914, p. 658.

Aschoff, L.: Pathologische Anatomie, 1911, Bd. 2, p. 798.

Barbour, A. H. F., and Watson, B. P.: Tuberculous Pyosalpinx, Jour. of Obstetrics and Gynæcology of the British Empire, September, 1911.

Batzdorff, E.: Ein Beiträge zur Frage des Primären Appendixcarcinoms. Langenbeck's Archiv für klinische Chirurgie, 1912, xcviii, p. 76.

Beger, A.: Ein Fall von Krebs des Wurmfortsatzes, Berliner klin. Wochenschrift, 1882, xli, s. 616.

Boyer, E. E. H.: Primary Carcinoma of the Vermiform Appendix: A Review of the Literature With a Report of Two New Cases, Amer Jour. of Med. Sciences, 1919, clvii, p. 775.

Brewer, G. E.: Discussion on LeConte's Paper, Trans. Am. Surg. Assoc., 1908, xxvi, p. 454.

Child, C. G.: Coexistent Diseases of the Appendix and Pelvic Organs in the Female, Amer. Jour. of Obstetrics, 1919, lxxx, p. 31.

Coley, W. B.: Discussion on LeConte's Paper, Trans. Amer. Surg. Assoc., 1908, xxvi, p. 454.

Elting, A. W.: Primary Carcinoma of the Vermiform Appendix, ANNALS OF SURGERY, 1903, xxxvii, p. 549.

Ewing, James: Neoplastic Diseases, 1919, p. 644.

Harte, R. H.: Primary Carcinoma and Sarcoma of the Appendix Vermiformis, Trans. Am. Surg. Assoc., 1908, xxvi, p. 399.

Huntington, G. S.: The Anatomy of the Human Peritoneum and Abdominal Cavity, 1903, p. 218.

Kelly, A. O. J.: Primary Carcinoma and Endothelioma of the Vermiform Appendix, Amer. Jour. Med. Sciences, 1908, xxxv, p. 851.

Kelly, Howard A.: Appendicitis and Other Diseases of the Vermiform Appendix, 1909.

LeConte, R. G.: Carcinoma of the Appendix, With Metastasis to the Ileo-colic Glands, Trans. Amer. Surg. Assoc., 1908, xxvi, p. 445.

Letulle and Weinberg: Bulletin de la Société Anatomique de Paris, 1897, lxii, p. 747 and p. 814.

Lubarsch, Otto: Ueber den Primären Krebs des Ileum Nebst Bemerkungen Über das Gleichzeitige Vorkommen von Krebs und Tuberculose, Virchow's Archiv, 1888, Bd. cxi, s. 281.

Mallory, F. B.: The Principles of Pathologic Histology, 1914, p. 487.

Mayo, W. J.: The Prophylaxis of Cancer, Trans. Am. Surg. Assoc., 1914, xxxii, p. 1.

Milner, R.: Die Entzündlichen Pseudo-Karzinome des Wurmfortsatzes, Deutsche medicinische Wochenschrift, No. 25, 1910, xxxvi, p. 1191.

Moschcowitz, A. V.: Primary Carcinoma of the Appendix, ANNALS OF SURGERY, 1903, xxxvii, p. 891.

MacCarty, W. C., and McGrath, B. F.: The Frequency of Carcinoma of the Appendix, ANNALS OF SURGERY, 1914, lix, p. 675.

McWilliams, C. A.. Primary Carcinoma of the Vermiform Appendix, Amer. Jour. Med. Sciences, 1908, xxxv, p. 822.

Neugebauer, F.: Ueber Gutartige Geschwülste, Carcinome und Sogenannte Carcinome des Wurmfortsatzes, Beiträge zur klinischen Chirurgie, 1910, Bd. 67, s. 328.

Oberndorfer: Discussion of Winkler's paper, *vide infra*.

Reiman, S. P.: Primary Carcinoma of the Vermiform Appendix, Amer. Jour. of Med. Sciences, 1918, clvi, p. 190.

Ross, G. G.: Carcinoma of the Appendix, ANNALS OF SURGERY, 1911, liv, p. 277.

Winkler: Krebs des Wurmfortsatzes, Centralblatt für allgemeine Pathologie und pathologische Anatomie, 1910, Bd. xxi, s. 167.

Zaaijer, J. H.: Primäres Carcinom des Wurmfortsatzes, Beiträge zur Klinische Chirurgie, 1907, Bd. 54, s. 239.

RADICAL OPERATION IN CASES OF ADVANCED CANCER

By John W. Churchman
of New York, N. Y.

No problem which the surgeon has to face presents greater difficulties than the decision, in a given case, as to the operability of a malignant growth. In the very early cases the duty to intervene is clear enough; and in the very late cases attendant circumstances, like metastasis at a distance, may, in equally definite fashion, indicate the wisdom of conservatism. Many cases, however, lie between these two extremes; the growth is large, or neighboring lymphatic involvement is extensive, or there are adhesions to adjacent organs; shall one take the infinitely small chance which radical removal offers, or allow Nature to take her course?

The answer to this question, which is in part determined by the temperament of the surgeon concerned—whether conservative or bold—indicates that surgeons are divided into two camps on this point. Many men, and among them are those whose experience is limited and whose nerve is more noteworthy than their judgment, will attempt to remove any growth, and not infrequently delude themselves with the notion that an operation of the most incomplete sort has been a "radical resection." Fearful of the disrepute into which this sort of thing brings surgery, other surgeons refuse to operate at all unless there is good chance of expecting a cure. Some men have even been known to go so far as to refuse the relief of a gastrostomy to a patient suffering from cardiac cancer, because the reputation for failure which surgery may get when operation is undertaken and cure does not result, prejudices the public mind and prevents patients from presenting themselves at a time when cure might be effected.

There can be no question that as one's experience in the surgery of cancer increases one tends to draw away from the extremely radical, and approach the conservative camp. Repeated disappointment—in cases in which, hoping somewhat against hope, an extremely extensive removal has been done only to be followed by fairly prompt recurrence—is sure in time to dim one's ardor as to the value of surgery in any, save the early cases of cancer.

It is extremely easy to get into this state of mind, particularly in a hospital, where all sorts of cases, even the most desperate, must be handled; for it relieves one of the disagreeable burden of undertaking large operations when the chance of cure is slim. There are three reasons why it is a dangerous point of view.

1. Once this attitude is taken it will be found that the kind of case regarded as hopeless will be more and more frequent. At first only cases *really* hopeless will be refused operation; then cases with a bad prognosis;

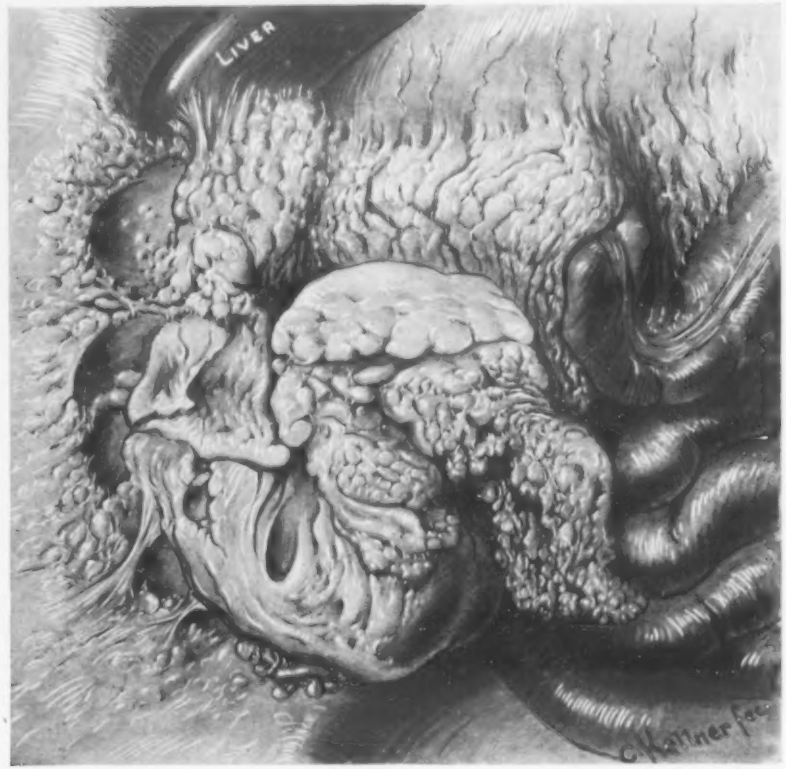


FIG. 1.—Appearance on opening the abdomen. The omentum is adherent to the cecal mass, to the liver and to the ascending transverse colon.

FIG. 2.—The bowel has been hardened in distention before opening. The cancerous mass has almost entirely obliterated the lumen.

FIG. 3.—Microphotograph of tumor.

and finally even exploration will be avoided unless there is every indication that a curative operation can certainly be done.

2. Surgeons are under obligation to relieve as well as to cure; yet there is danger, if exploration in possibly inoperable cases is refused, of missing a chance to give relief. *"Guèrir quelquefois, soulager souvent, consoler toujours"* is a good rule for surgery as well as for medicine.

3. There is no way to determine accurately the prognosis in a given case. All the criteria of relative malignancy we have, though some of them are of value, are of a rough kind. Occasional cases do well even when the pathological picture, both gross and microscopic, is unfavorable. It is this occasional case which obligates the surgeon to offer operative relief wherever removal, that can in any sense be regarded as complete, is possible.

I wish to report a case which belongs in the group of "clinically inoperable cancer," but in which an extremely satisfactory result has followed radical operation. The patient was referred to me by Dr. C. P. Lindsley, of New Haven, Conn. He was a man sixty years of age who for several months had been suffering from attacks of partial intestinal obstruction. The pain, nausea, and obstinate constipation had in each instance been finally relieved by catharsis and enemas; but with each subsequent attack the difficulty of relief was becoming greater. Meanwhile the appetite was becoming poor and the patient was rapidly losing weight. When I first saw him, the clinical picture was typical of nearly complete obstruction of the large bowel, and the presence of a large mass in the right side of the abdomen at about the level of the umbilicus made only too clear what the nature of the obstruction was. At this time the patient was about sixty pounds under weight.

The obstruction, of course, demanded immediate relief, but it was feared, on account of the fixity of the tumor, and its size, that an enterostomy, or at best a short-circuiting operation, would have to be done. On opening the abdomen, the condition found seemed to justify this fear (Fig. 1). The abdomen was full of serous fluid, the omentum glued to the transverse colon, liver, cæcum, and intestinal coils, the cæcum fixed to the lateral and posterior abdominal walls. The small bowel was moderately distended, the transverse colon collapsed. A carcinomatous mass was felt on the posterior wall of the cæcum, near the ileocæcal valve, and many enlarged glands were palpable in the neighborhood. The adhesions of cæcum and omentum proved not very firm, and without much difficulty or hemorrhage the entire mass could be freed by slowly sweeping the hand about it. A resection was determined upon as the most satisfactory palliative measure; the hope of a cure was hardly entertained. A lateral anastomosis was done.

For the operation an incision across the rectus was used. This, in my opinion, is the incision of choice in all extensive abdominal operations. It provides abundant room, without dragging at re-

tractors, and not only makes the procedure easier, shorter, and safer, but makes possible a really intelligent opinion as to the possibilities of the case by giving room to see and feel. If the rectus fascia is neatly divided and is overlapped in the closure, the abdominal wall is stronger after the operation than before.

The post-operative course was without event. The drainage tract closed promptly and the patient was at home, with the wound entirely healed, in four weeks.

The lumen of the bowel had been nearly obliterated by the growth (Fig. 2) which microscopic section showed to be an adenocarcinoma (Fig. 3).

The operation was done in December, 1917. The patient gained sixty pounds in the first year and is at the present time to all appearances well. There is no sign of recurrence. That recurrence will ultimately appear seems more than likely, but the several years of good health and complete comfort which the patient will have enjoyed justifies the wisdom of the decision to resect.

It seems quite probable that if the obstruction in this case had not presented an emergency demanding relief the appearance on opening the abdomen would have justified the belief that the case was hopeless and nothing would have been done. Occasional successes of this sort should act as a stimulus to do all that can be done for patients with extensive cancer, though one must, of course, be prepared for failure in a large proportion of cases.

RADIUM IN THE TREATMENT OF CARCINOMA OF THE CERVIX UTERI

A DISCUSSION OF THE PROBLEMS CONNECTED WITH THE OPERATIVE AND RADIUM TREATMENT

By Edward H. Risley, M.D.
of Boston, Mass.

It is desired to present a paper on the treatment of carcinoma of the cervix which shall be more in the nature of a discussion of several important factors relative to operability, selection of cases for operation, precancerous conditions, results to be expected from operation, other purely palliative methods and the present status of radium—than a presentation of cases and reporting of end-results.

This is a subject in which the author has been much interested for the past six years and to which much thought and time have been devoted. A discussion of this kind seems particularly in point at the present time, because the subject is one about which our ideas just now are undergoing considerable revolution.

We stand more or less at a parting of the ways in regard to the treatment—no longer of the inoperable cases—but now of those that are unquestionably recognized to be operable. The advocates of the extended or Wertheim operation are beginning to weaken in their belief that this is the procedure *sine qua non* for operable carcinoma of the cervix, in the face of the accumulative evidence from many clinics the world over, that operation is not the only means of actually curing cancer in this region.

Such a profound change is apparently taking place at the present time in the minds of many of the foremost surgeons of the world in regard to the treatment of this disease that it behooves us to try to get at the facts as they really are and to carefully weigh the evidence at hand.

For the sake of later discussion we shall endeavor to present:

1. The essential facts in regard to surgery and the operative end-results, and

2. As nearly a correct statement as we can in regard to what is to be expected from radium alone.

In this paper statistics in regard to our own end-results are purposely avoided for the following reasons:

1. We have been using the technic outlined below in the treatment of the borderline case only about three and one-half years, and as we use the five-year period as a standard for estimating probable clinical cures our series is yet too young to be reported as end-results.

2. Our technic in the application of radium is now entirely different from our former method, the new method only being in use since July; 1919; therefore, end-results in these cases are not yet available.

On the other hand, putting statistics aside, we are strongly of the feeling that certain impressions gained from the examination and care-

ful following up and experience with several hundreds of cases each year gives a sound basis of knowledge, which, in many instances, is of as great value in forming a final judgment about cases as are masses of figures. These will be referred to more in detail later.

Success in the treatment of carcinoma of the cervix depends, of course, as in carcinoma elsewhere, on the earliest possible diagnosis. And in this connection it would seem wise to call attention to a phase of this subject which has received scant attention in the past, which we now more and more realize is of greatest importance. I refer to the early recognition and diagnosis of the so-called pre-cancerous conditions, which must be recognized both by the general practitioner and the surgeon if our end-results are to be improved and our cases brought to earlier operation and our percentage of cures increased. We have the impression that to the average practitioner the term "pre-cancerous" is not entirely clearly defined. The following enumeration indicates the type of lesion under this heading which should be looked upon invariably with suspicion, whether they occur in the young woman of child-bearing age or in those of a more likely cancerous period.

Further and further acquaintance with malignancy of all types impresses one with the great frequency with which it occurs, not alone in those of middle life, but also in the young, in whom it is practically always of a more virulent nature than in older subjects. Malignancy as known to-day should no longer be considered a disease of old age.

The following are the commonest pre-cancerous conditions in the cervix: Lacerations of the cervix. Erosions of the cervix. Ulceration of the cervix. Cystic disease of the cervix. Polyps of the cervix. Any hypertrophy of the cervix.

All of these in any stage of development may be the forerunner of malignant degeneration and should be looked upon with suspicion.

Of course, it is to be understood that this does not apply to the recent laceration or eversion-erosion after labor, but only to those which do not tend to heal readily and which become more or less chronic in character, as evidenced by more or less discharge, œdema, sluggish ulceration, and failure to heal under appropriate treatment.

So important is it to rule out these conditions as possible precursors of malignancy, that it is believed that every such case that comes for operative relief—and many others—should be subjected to removal of a specimen for microscopical diagnosis. Only by going to this seeming extreme can we hope to get our cases early enough for a probable cure by the extended operation. It would seem wise to urge that it be made a routine practice in all hospital clinics to submit for microscopical study a specimen from every case operated on for laceration, ulceration, erosion, hypertrophy, or polyp of the cervix. In this way many cases of malignancy will undoubtedly be discovered, an early radical operation

done, and a surgical cure made, while other clinically suspicious cases will be proved benign and saved from the dangers of the major operative procedure.

Cures in carcinoma of the cervix depend, first, on the earliest possible diagnosis and earliest possible resort to operation, and secondly, on the careful selection of cases, with the avoidance of possible borderline cases (defined later), and thirdly, on the type of operation used. It is now recognized that no half-hearted or palliative surgery is justifiable in the early operable case. Vaginal, supravaginal hysterectomy, amputation or cauterization of the cervix alone are never radical enough proceedings in the operable case and should be reserved solely for palliation in the distinctly inoperable case.

It is contended by some that anything short of an extensive procedure like the Wertheim operation is almost criminal negligence and should neither be contemplated nor practiced, while other surgeons feel that, because of the diffuse extent of lymphatic involvement in the deep pelvis and the probable impossibility of getting rid of all involved lymphatics even with the most extensive dissection, the cases cured by the Wertheim operation are probably only those cases that would have been cured anyway by a less extensive procedure, such as the ordinary total hysterectomy which extirpates the cervix and body of the uterus and a certain amount of parametrium. In view of the success which often follows cautery or radium alone, this latter expression of opinion probably has a sound basis of fact.

In a discussion of this kind it is necessary to have in mind the essential facts in regard to the Wertheim or extended operation, the kind of case suitable for this operation and the end-results to be expected from this and from other procedures.

Our results are largely dependent on the types of case with which we have to deal, and it is, therefore, believed that greater precision in the description of the type of case dealt with should be used in order that we may get clearer ideas of result to be expected.

One must recognize definite groups, namely, (1) early and definitely localized growths involving the cervix only (the definitely operable cases); (2) cases of borderline operability (defined later); (3) cases of extensive involvement of the cervix, but operable because confined entirely to this organ, and (4) definitely and unquestionably inoperable cases.

The question of operability is one of the greatest importance and one also which we are reluctant to say we fear depends to a too great extent on the personal equation, ability and experience of the surgeon consulted. Perhaps this is necessarily so, because no one man has at hand statistics enough of physical and operative findings and end-results by which to be accurately guided in his decision.

A review of the cases seen at such a clinic as the Huntington Memorial Hospital in Boston, while it does not furnish large masses of figures, yet gives an impression of cases which we feel is of distinct value

in forming an estimate of operability, prognosis, value of certain lines of treatment, etc.

Many cases are sent to us for diagnosis and advice as to the best form of treatment, while others are those of recurrence after various operative procedures. From these two groups of cases, especially, a very definite idea of operability has been formed, and is further confirmed by an analysis of the results of large series of cases presented by such men as Wertheim, Kelly, Clark, Jacobson, Janeway and many other men of less extensive experience.

We would, therefore, define the different degrees of operability and follow this by a discussion of the forms of treatment which seem most productive of good results in cases not suited for the extended operation.

It is true that the further the lay public and the physician are educated into making early diagnosis and the percentage of operability increases in this way, it is also found to be true that the more the surgeon analyzes his cases and his own and other end-results there will be found an increasing number of cases that are not suited for operation by the extended method, but which must be treated by methods which, while only palliative, are as they are perfected giving increasingly good results.

We would define the operable case as that in which there was no contra-indication in the general condition of the patient, in which the disease is diagnosed early, in its incipiency, is definitely localized in the cervix without encroachment on the vaginal wall, and in which there is no induration in the broad ligaments or fixation or enlargement of the uterus and no evidence of metastases or extension to iliac or inguinal glands, liver or elsewhere. And we would define the borderline case as one in which the disease was not sharply localized on the cervix, in which there was some encroachment of the disease into the vaginal wall or in which any amount of fixation was present as evidenced by a slight amount of thickening in the broad ligament; especially as detected by rectal examination, which always gives a much more definite estimate of the amount of pericervical involvement than can be obtained by vaginal examination.

This is the type of case in which it is believed the greatest number of errors of judgment are made in advising operation rather than more conservative methods.

The borderline case is rarely the operative case, and this statement is based upon the large number of cases seen at our clinic in which rapid recurrence has followed attempts at removal in this class of case.

The cases in which pericervical thickening and fixation are due to chronic inflammation of the appendages and not to carcinomatous infiltration are very rare, and the fact of the existence of the above two signs or of vaginal wall encroachment or induration of the broad ligaments, practically always means that the surgeon, in trying to effect a wide excision of the diseased area, of necessity is forced to cut through

tissue already invaded or so lowered in resistance from its close proximity to an area from which it absorbs toxic material that rapid recurrence or extension of the disease follows operation. Even the widest dissection in this type of case but rarely gives a cure.

Recurrence here is met with in the stump of the broad ligament more frequently than elsewhere, and in this situation is less accessible for treatment than almost anywhere else.

Thus, from observation of the frequency and situation of recurrences after attempts at the extended operation in the borderline case, we hesitate to recommend for the radical procedure even patients who are otherwise in good condition, but whose disease places them in this category, knowing, almost to a certainty, that because they fall into this group they will have early recurrence.

This would seem a pessimistic view for the surgeon to take, but it is based on observation of a considerable number of cases seen in a clinic where all varieties of cases are carefully studied and where many end-results are seen. It is believed that the importance of avoiding the radical operation in the borderline case cannot be too strongly emphasized. The more cases one sees in which attempts at extirpation in this class of case are promptly followed by rapid recurrence, the stronger is the belief that operation should be carefully avoided in this particular group.

There is another group of cases about which we have so far been unable to form a definite decision as to their chances of recurrence after panhysterectomy, but which we are inclined to believe are more operable than the borderline case. It is that group in which there is rather extensive involvement of the cervix or destruction of tissue at the cervix, but which shows no tendency to extend or to encroach on surrounding tissues. This is more liable to be the adeno than the squamous cell type.

Therefore, it is believed that the cases selected for the radical operation should be restricted to those rather few cases in which the surgeon is practically certain that he can get all around the disease with a wide margin, and in which there is absence of induration of the broad ligaments or fixation.

All cases in which the surgeon is in doubt as to his ability completely to extirpate the disease with a wide margin should be operated not by the radical method, carrying its high primary mortality, but should be reserved for the simpler procedures outlined below. With the publication in 1898 of the Wertheim operation and its adoption by the leading gynæcological clinics of the world, it was thought that a step forward had been taken in the war against uterine cancer, but now after two decades we find this operation still on trial.

The reasons for this are: (1) The very low percentage of operability by this method. In ten years Clark operated on 60 patients and found during that same period over 300 who were inoperable. An operability of only 15 per cent. In Jacobson's collection of 5027 cases only 1720, or a little

over 31 per cent., were considered operable. (2) The high primary mortality. In Jacobson's large series primary mortality was 18.25 per cent., and in other European and American series it is found to range from 11 to 28 per cent. These results are the reports from the largest gynæcological clinics and represent the efforts of the most skilled surgeons, which shows how unsatisfactory they really are.

Janeway grouped and classified all the reliable, available statistics and finds that cases with early diagnosis and early operation in the hands of skilled men should present only about a 15 to 30 per cent. operability, 15 to 18 per cent. immediate mortality, and 11 to 19 per cent. cures (five-year period) of those surviving operation.

Even this percentage of cures carries with it a 7 to 40 per cent. evidence of incurable vesico-vaginal fistulæ, incontinence, necrosis of the bladder, injury to the rectum, and other distressing and disabling sequelæ even in the hands of the most experienced men.

These results are evidently far from ideal. I might here quote Clark, who says: "If an operation or other therapeutic procedure is to have a permanent place in our armamentarium it must be sufficiently easy to make it available, not for a few skilled specialists, but for the great body of surgeons working in every quarter of this and other countries. In these days of low mortality percentages attending nearly all of the major operations, no operation can possibly gain headway which combines with it a shockingly high primary mortality and a large number of distressing sequelæ."

However, so far, in the absence of a known, proved method which can give better end-results, the Wertheim operation is still the method of choice with the majority of American surgeons, but probably not any longer with the greatest of the continental gynæcologists. As far back as 1914 Dobbert concluded, after an experience with 24 cases, 18 inoperable and 6 operable, that it was justifiable to use radium in the treatment of the operable case. Cheron used radium in an inoperable case and two years later, the patient dying of an intercurrent disease, autopsy showed no trace of cancer. In 1915 Döderlein advocated the use of radium in inoperable cases and Pozzi that same year gave up the Wertheim operation in borderline cases and treated them with radium alone.

A careful consideration of the results to be expected from the Percy cold cautery method would lead one to believe that this procedure, followed, as it is, by a high percentage of recto- and vesico-vaginal fistulæ, pelvic peritonitides and other operative and post-operative accidents, and failures to cure, should be definitely ruled out in the treatment of the operable case.

Such are the facts regarding the present status of the treatment of the operative case—and the trend of thought in regard to radium.

Now let us turn to the treatment of the borderline case.

For this type of case when there is either some encroachment on the vaginal wall or more or less induration in one or other broad ligament,

the hope of complete extirpation, even with the widest dissection, is small.

It, of course, may be contended that induration of the broad ligament does not necessarily mean extension of the actual disease to this region, but may be the result simply of the œdema surrounding any well-developed malignant process. Nevertheless, there is no way of ascertaining beforehand—nor always even at operation—whether this induration is due to œdema only, and a careful study of the location of recurrence and knowledge of the areas where disease is most commonly cut through in trying to do a radical dissection, makes it certain that in the majority of cases broad ligament induration, with its accompanying fixation of the lower segments of the uterus—no matter how slight it may be—means inoperablity.

Also from the point of view of the actual pathology of such cases the presence of œdema means dilated and hence easily traversed lymph channels, by which cancer infection probably will later spread if it has not already done so.

Therefore, for the borderline case two methods of procedure are open. (1) Cautery plus radium, if there is enough protruding disease at the cervix to warrant the preliminary use of the cautery to get rid of mass, or (2) radium alone.

The technic which we have employed when the cautery is used is as follows and applies also to the extensive inoperable case as well as to the borderline case.

Using the water-cooled speculum and the electric cautery, a thorough cauterization is done with the actual cautery of all accessible diseased tissue; a cauterization which shall burn away and destroy all nodular or protruding growth and which shall convert the diseased cervix into a definite cavity from which all macroscopic disease has been removed. It is customary to slowly cook the diseased area until all accessible tissue can be easily removed by gentle curettage, to reapply the cautery still further, follow this by further curettage, and so on, repeating each step over and over until all disease is removed as far as can be discovered. To do this thoroughly requires much time and patience. If done in this way there is very little danger of dissemination of the disease by the curette, and a smooth-walled cavity, lined with an eschar, surrounded by presumably healthy tissue, is left into which radium is immediately placed in doses of from 75 to 200 cm. and left in for twelve hours to sixteen hours.

Post-operative Treatment.—This should be followed by further radium treatment given at intervals of about three or four weeks until all signs of disease have disappeared. And after this the patient should report for observation every month for at least six months and then every three to six months for at least three years.

There is no objection to repeated cauterization of a rapidly growing localized disease, and good results and much prolongation of life with alleviation of suffering have resulted from this procedure. Cauterization

has also been successfully applied to local recurrences in the vault after panhysterectomy previous to giving of radium, with reduction in the size of the area to be treated, and with much local improvement, and apparent shortening of the radium treatment.

This is a procedure which we have found of greatest service in the inoperable cases, in many of which the disease has all but been destroyed —and certainly so delayed in its progress that patients with pain, hemorrhage, and foul discharge have been given complete relief for many months at a time, and a miserable, hopeless existence converted into a comfortable and happy one. With proper handling and enough attention to detail the inoperable case is one for whom much that is worth while can be done.

These are not the words of the enthusiast, but the gratifying experience resulting from the treatment of large groups of inoperable and seemingly hopeless cases.

The rationale of the combined cautery-radium treatment in the borderline case is based on four factors. (1) Failure of the extended operation to cure in a reasonable percentage of cases—and rapid recurrence in this type of case. (2) The high primary mortality and definite disability incidence in the operated case as against the total absence of immediate mortality and distressing sequence with our method. (3) The considerable percentage of cures or freedom from disease for long periods resulting from cauterization alone. (4) Recent improvement in results with radium alone.

At the present time, because of the relatively poor results from operation, even in the hands of the most skilled, the question of radium treatment and what can assuredly be expected from it is of greatest importance to determine.

In this connection the author believes that a conservative statement taken from the point of view of the clinical surgeon and not from that of the radium specialist will be of value.

For the past six years we have been especially interested in carcinoma of the cervix and also in its treatment in the inoperable and recurrent form by radium. We have had under our direct supervision all of the cervix cases at the Huntington Memorial Hospital during this time, where large numbers of cases are seen each year. We have undertaken this work with no preconceived faith in radium, but have been trying to find out for ourselves—unprejudiced by outside (generally enthusiastic) reports—just what radium can or cannot do.

We have struggled along for several years utterly discouraged with end-results. Temporary results and palliation were often encouraging, but end-results were apparently hopeless.

Not until within a year, when an entirely different technic of application has been adopted, have results begun to be at all promising. The old method used to be that of placing radium—in altogether inadequate

doses—in variously modelled applicators *against* the outside of the cervical disease. Small areas were destroyed and symptoms largely relieved, but the great mass of the disease remained intact.

But now all cases are treated by direct insertion of three times the former dose, in unscreened steel-jacketed needles, directly into the cervical canal or other mass of disease. In this way large masses of disease are destroyed at one sitting, treatments can be given at greater intervals, and a marked change has been noted.

All of our cases treated by the new method are under a year, and we therefore refrain from making any report of results, no matter how promising some of the immediate effects seem to be. It seems evident, however, that failures in the past have possibly been due to faults in the technic of applying radium. Coincident with our own work the results obtained by Janeway, Ransohoff and others would indicate that increasingly encouraging effects were being secured by greater attention to the details of radium application.

That radium has a definite place in the treatment of the inoperable and border-line cases, I think there is now undisputed evidence.

Our feeling about early discovered and well-localized carcinoma of the cervix in the patient who is a good surgical risk is that it should always be treated by the most thorough operative removal consistent with the safety of the patient, and we would not like to be misunderstood, from any remarks on other forms of treatment, as advocating any other less radical method in the unquestionably operable case. It is only in the borderline or inoperable case that we would urge against attempts at radical surgery—and for the intelligent use of now well-tried out and proved conservative methods.

This statement does not agree with the conclusions reached by Janeway or Ransohoff—the latter of whom comes out with the flat-footed statement that he no longer hesitates to state it as his opinion that radium treatment should entirely supplant operation, not only in the treatment of inoperable cases, but also in the treatment of the operable cases as well. This, I believe, is rapidly becoming the conviction of many more surgeons each year, as operative results show little or no improvement, but radium workers are more and more positively able to demonstrate what radium can do when properly handled.

It is believed that we are in a transition stage and that within two or three years the matter of the exact place of radium and operation in the operable cases will be definitely settled. Meanwhile, because of the proved value of radium in the inoperable and borderline cases and in the locally operable cases which have some definite general contra-indication to operation, it is hoped that more and more of this latter type of case may be sent for radium treatment and in this way convincing statistics accumulated which will soon settle the question once for all.

The treatment of the borderline case, we believe, is now a settled

one. It is with radium, or with cautery and radium, according to the character of the growth, and not by operation, for which this type of case has been proven to be unsuited.

It is now also pretty definitely settled that these cases are not made operable by preliminary radium treatment. Every surgeon who has attempted to do a panhysterectomy after preliminary radium treatment knows the great difficulty encountered from persistent oozing due to increased blood supply, and difficult dissection due to increase in fibrous tissue obliterating lines of cleavage at the very sites where the most delicate dissection is necessary in order to avoid important structures and the cutting into presumably diseased areas.

It is probably true that the borderline case that does well under radium treatment better continue to be treated with radium rather than to run the very definite risk in operation of stirring up semi-latent foci of disease and possibly causing rapid dissemination of the disease instead of obtaining an operative cure.

The treatment of the definitely inoperable case is also now standardized. It should be with cautery and radium if the mass is large or protruding, or with radium alone when the cautery is not indicated.

The recurrent case is best treated with radium should the recurrence be confined to the vaginal walls or vault, and by the combined use of radium to the vault and deep cross-fire X-ray in multiple areas to the sacral region and deep pelvis should there be involvement of the pelvis.

With greater efforts in the way of educational campaigns among the laity, with earlier diagnosis from more frequent removal of specimens for pathological diagnoses of suspicious pre-cancerous conditions, with earlier operation in the small percentage of operable cases, with improved methods of technic in the application of radium in the borderline and inoperable cases, with the combined use of X-ray and radium in the extensive cases and with a more perfect system of following up all cases in all classes, we believe that the percentage of actual cures in carcinoma of the cervix is going to be materially increased in the next few years.

It is evident from a review of recent literature that the trend of thought in regard to the treatment of operable carcinoma of the cervix is less and less sanguine as regards the extended operation, but more and more towards the use of radium.

Convincing statistics are rapidly accumulating which emphasize, on the one hand, the failure of operation to cure in a large enough percentage of cases to warrant placing it as the only means of curing the operable case, and, on the other hand, the increasingly good results to be obtained from and expected of radium when given by a proper technic and in sufficiently large doses.

We are unwilling at the present time to state definitely that we believe that radium will eventually supplant operation in the treatment of all operable cases, but, on the other hand, we cannot deny the convincing

evidence of the real advances made in radium technic and the highly satisfactory results obtained with radium alone.

It seems probable that with greater familiarity with the disease, with a more careful selection of cases—avoiding the acceptance for operation of any cases of the borderline type—that operation will soon be confined to a very small per cent. of distinctly operable cases, and that the remainder will be treated with increasingly greater success with radium alone.

Certainly radium has very definitely established its place firmly in our armamentarium as an agent which in the inoperable case can accomplish such a praiseworthy and definite diminution and often almost complete cessation of distressing symptoms that it must be looked upon as one of the greatest therapeutic advances of the age, especially when applied to carcinoma of the cervix.

BONE TUMORS. MYXOMA, CENTRAL AND PERIOSTEAL

THEIR RECURRENCE AFTER EXPLORATORY EXCISION AND PIECEMEAL REMOVAL

By Joseph Colt Bloodgood, M.D.
of Baltimore, Md.

In 1906 I observed a recurrence in the soft-part scar left by the removal one year previously of a small periosteal myxoma of the humerus. At the original operation the tumor was explored and removed piecemeal. This patient died in 1915, ten years after the operation, with metastasis to the chest and scalp. During these ten years there had been numerous operations for local recurrence in the soft parts and in the bone, until finally in 1912, seven years after the first operation, amputation was done at the shoulder-joint.

In this case both the original and all of the recurrent tumors retained the microscopic picture of a myxoma.

This was a very impressive experience, that a tumor considered histologically benign could recur by what appeared to be definite transplantation of tumor tissue at the operation, and finally lead to death from metastasis. (Case I, Figs. 1 and 2.)

Not until 1919, fourteen years later, did another similar case come under my observation, which so impressively indicated the danger of recurrence in myxoma when the tumor is explored and removed piecemeal. In this instance the original tumor was central in the astragalus. In March, 1918, the astragalus was removed piecemeal. One year later I saw the patient with recurrence of the tumor in the scar and amputated the leg above the ankle. Six months later he returned with a tumor of the same character involving the tubercle of the tibia of the stump. Then the thigh was amputated; at the present time (October, 1920) the patient is apparently well. Case II.

Between 1906 and 1919 I had this myxoma of bone constantly in mind, and in reading some old textbooks on surgery written from 1840 to 1880, I found quite frequently the statement by the older surgeons who had large experience with tumors: "The myxoma of bone is a benign tumor, but it usually recurs." In more recent textbooks and literature this pretty definite knowledge has been lost, and none of the recent authors seem familiar with this characteristic feature of the myxoma of bone.

In the Annals of Surgery for April, 1919 (page 357), in a contribution on Central Giant-cell Tumors, I discussed briefly Recurrence After Operation for Benign Connective-tissue Tumors, *and emphasized the danger of enucleating, or peeling out, or removing piecemeal, such tumors as the mixed tumor of the parotid, the intracanalicular myxoma of the breast, the fibromyxoma of nerve-sheaths, the epulis of the lower jaw, and especially the central and periosteal myxoma of bone.*

When the tumor must be removed by this method, chiefly indicated in the central giant-cell tumor of bone and in the epulis, one should thoroughly cauterize the wound with pure carbolic followed by alcohol, or with a piece of gauze saturated in 50 per cent. solution of zinc chloride, or, when possible, employ the electric cautery for the removal of the tumor. Of all the neoplasms mentioned, recurrence seems most dangerous in the pure myxoma of bone, as it usually leads to amputation because of the recurrence and in some instances to death from metastasis.

Since the experience with Case II in 1919, I have gone over all of our records in the Surgical Pathological Laboratory of the Johns Hopkins Hospital and find that in every case of periosteal and central myxoma in which the original tumor has been explored and removed piecemeal, there has been recurrence, while in every case resected or amputated without such exploratory incision the patients have remained well, both from recurrence and metastasis.

I do not include in this group myxosarcoma.

I have as yet no experience of what will happen when we explore myxomas and, after making the diagnosis, locally remove the tumor with the precaution noted. In Case II, when I explored the upper end of the tibia and exposed a myxomatous area destroying the tubercle, I explored with the cautery, packed the wound with a piece of gauze saturated with zinc chloride, and three days later amputated above the knee-joint. I did this, because I feared there might be other areas of myxoma in the stump of the first amputation, and amputation above the knee-joint would give almost as good function with the artificial limb the patient already had.

Myxomas of bone are rare tumors. They occur both as periosteal and central tumors. In the beginning they may be small and can be removed without sacrificing the limb by amputation. In some cases resection and bone transplantation will be indicated. But as in the cases about to be reported, I do not see how a diagnosis can be made without an exploratory incision. Therefore, it is of the utmost importance to have in mind a technic which will allow the conservative operation without this danger of recurrence by transplantation of tumor tissue into the uninvolved wound of exploration.

I have not been able to get evidence that either X-rays or radium will destroy a myxomatous tumor of bone. Perhaps in these cases it might be worth while to try radium and the X-rays before operation under X-ray control.

The myxomas occur as periosteal and central growths unmixed with any other tissue, they may frequently be found combined with chondroma, rarely with exostosis. I will report here (Case III) a tumor that had the X-ray picture of a benign exostosis; it was removed piecemeal; there was recurrence and death. When I studied the tissues

removed from this case, I found areas of myxoma. Up to the present this is the only exostosis, among 110 cases, with areas of myxoma, and the only one in which the recurrence led to death.

Although the problem is yet unsettled, it seems important to publish these three very instructive observations, in order to call attention for the first time in recent literature, in a separate article, to this very serious result when central or periosteal myxomas are explored and removed piecemeal.

One gets the impression, at least from these three cases, that the patients might have lived longer and in greater comfort if they had been left alone; or if amputation had been done without exploratory incision, but there was nothing in the X-ray picture to justify such an amputation.

For this reason, when a bone tumor is explored, one should always have in mind the possibility of myxomatous tissue, whether central or periosteal, and especially so in all cartilage tumors.

The differential diagnosis between young, soft cartilage tissue and myxoma, can only be made by an immediate frozen section. To make this diagnosis one must be familiar with the histology of pure myxoma and young cartilage.

The pure chondromas are a separate group and must be discussed in a second article.

The danger of recurrence, when a pure chondroma is explored and removed piecemeal, is distinctly less than in the myxoma, but my recent studies have demonstrated that recurrence due to transplantation of pieces of the cartilage tumor is also possible. One recent experience seems to show that radium may inhibit or even destroy a small cartilage growth.[1]

I have called attention to the danger of recurrence in the pure myxoma in my reviews in *Progressive Medicine* and in the reference already given, and in an article about to be published in the *Journal of Radiology*. But this is the first time that I have made a contribution devoted exclusively to myxoma of bone, and this contribution is made possible by the most careful restudy of the three cases described in detail in this paper, and a short summary of our entire experience with myxomas of bone.

CASE I (Pathol. No. 6773).—Figs. 1 and 2. (Previously reported in *Progressive Medicine*, December, 1906, page 222, Fig. 19.) *Periosteal Myxoma of Shaft of Humerus.*

This patient, a white female, aged fifty-three years, was admitted to Johns Hopkins Hospital in May, 1905, because of local pain and a small tumor in the middle of the shaft of the left humerus. She was quite positive that she had had a tender spot in the region

[1] A second recent case of recurrent chondroma of the knee-joint did not react to radium (October, 1920).

of the present tumor for twenty years, but the little nodule had been felt only nine months; she remembers an injury to this arm, but was not certain whether this occurred before or after she experienced pain. The little lump has not grown rapidly, but since its appearance there has been more pain, and the area has become distinctly tender when struck. The X-ray (Fig. 1) shows a distinct periosteal growth resting on the shaft of the humerus, surrounded and almost encapsulated by a collar of bone. There is no evidence of bone destruction of the shaft beneath the lighter area.

In view of a pretty distinct history of syphilis twenty-six years ago, the condition was diagnosed as lues, and the patient was given mixed treatment for several months. On examination nothing could be made out but a small palpable nodule fixed to the shaft of the bone. It felt smoother than the usual exostosis, and the X-ray demonstrated that the larger part of the growth was not bone. The chief indication for operation was the pain, increasing tenderness and apparently the increase in the size of the growth.

At the exploration it had the appearance of a benign myxoma. The danger of exploring a myxoma at that time was not known. After demonstrating the apparently benign character of the growth, it was separated from the surrounding soft parts and chiseled off from the shaft of the humerus. The exposed shaft showed no evidence of infiltration.

The microscopic study made by me at that time (Fig. 2) showed a pure myxoma.

It is not necessary to describe in detail the history of the frequent recurrences, but the first one, one year later, was in the soft parts, and between the original operation in 1905 and 1910—a period of five years—there were five operations for either recurrence in the soft parts or in the shaft. Finally in 1910, so much bone of the shaft had been removed that fracture took place. Later, when this fracture was plated, there was no evidence of recurrence, and there was an interval of more than one year apparently free from recurrence, and finally in 1912, seven years after the first operation, the recurrence in the remaining shaft and soft parts was so extensive that the arm was amputated at the shoulder-joint. There was then a free interval of about eighteen months, when the patient returned with metastasis to the scalp and mediastinum. Death took place in 1915, ten years after the first operation. There was no autopsy, and no opportunity to study microscopically the scalp and mediastinal tumor.

As mentioned before, all the recurrent tumors, whether in bone or soft parts, retained the picture of a pure myxoma with no sarcomatous areas.

Case II (Pathol. No. 22929).—*Central Myxoma of Astragalus.*

This patient came under my observation April 5, 1919. The first operation was performed by a colleague in March, 1918, when the astragalus was completely removed piecemeal. The history was somewhat confusing: In the first place, for two years

there had been pain in the wrist, elbow and ankle, a history of tonsillitis and gonorrhœa. His tonsils had been removed and the gonorrhœa treated. Even at this time he had some pain and swelling of the right ankle, but up to January, 1918, the ankle apparently gave the patient no more trouble than the other joints. In March, 1918, he returned again, because the right ankle was giving him more trouble and was more swollen. For this reason an X-ray was taken and was diagnosed by the röntgenologist infectious arthritis. The movements of the foot and the ankle were limited and painful, and the chief pain was referred to the head of the astragalus. The pain and swelling of the other joints had disappeared and not recurred.

The X-ray (Fig. 3) should not have been interpreted as infectious arthritis, as the chief lesion is central. The anterior portion of the astragalus contains a definite light shadow, but there are no changes in any of its joint surfaces. The anterior surface of the astragalus between the tibia and the scaphoid shows partial destruction of the thin outer table and a slight bulging of bone—a picture we frequently see in bone cysts and giant-cell tumors. In my opinion this should have been interpreted as a central lesion of the astragalus of a neoplastic and not inflammatory type, including the bone cyst in the neoplastic group.

Central Tumors of the Astragalus.—Up to the present time I have records of two other central tumors of this bone—one a bone cyst in a male, aged twenty, in which there had been pain after trauma one year ago, and swelling four months; the other, a giant-cell tumor in a colored female aged thirty-three, in which there had been pain and swelling five months. These two patients have remained well after curetting, leaving the bone shell.

In the central myxoma of the astragalus under discussion the operator explored. The subcutaneous tissue over that portion of the astragalus which, in the X-ray, shows changes in the bone shell, was œdematous, and irregular new bone formation was found. It is to be remembered that the operator had in mind an infectious arthritis. In attempting to remove this irregular bone he exposed the cancellous bone of the astragalus and found it largely replaced by a softened myxomatous tissue with, here and there, reddish currant-jelly areas. The entire astragalus was then removed piecemeal, and the tissue sent to the laboratory is shown in Fig. 4. The larger pieces are the inner surfaces of the bone shell attached to which are the remains of cancellous bone, and the smaller pieces are myxomatous tissue containing no bone.

The wound was closed without attempt at chemical or electric cauterization.

Microscopic Diagnosis.—Fig. 5 illustrates a typical myxomatous area. The irregular darker areas are minute particles of bone. There are no cellular suggestions of sarcoma, and no evidence of ostitis fibrosa. This picture is a definite pathological entity and can be recognized by the stellate and lymphoid cells imbedded in an unstaining intercellular substance. Fig. 6 is from one of the

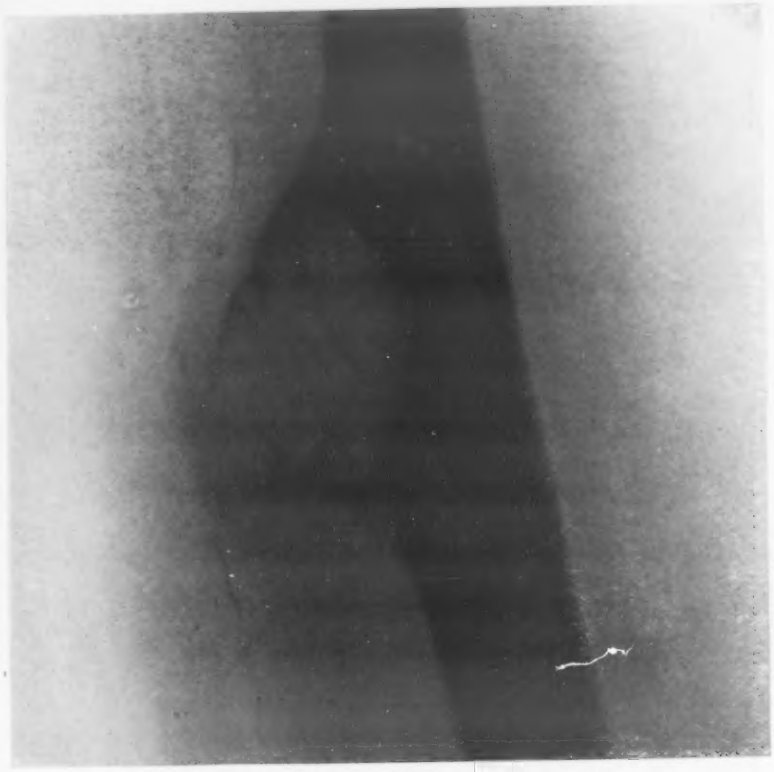


FIG. 1.—Case I (Pathol. No. 6773). Periosteal myxoma of humerus.

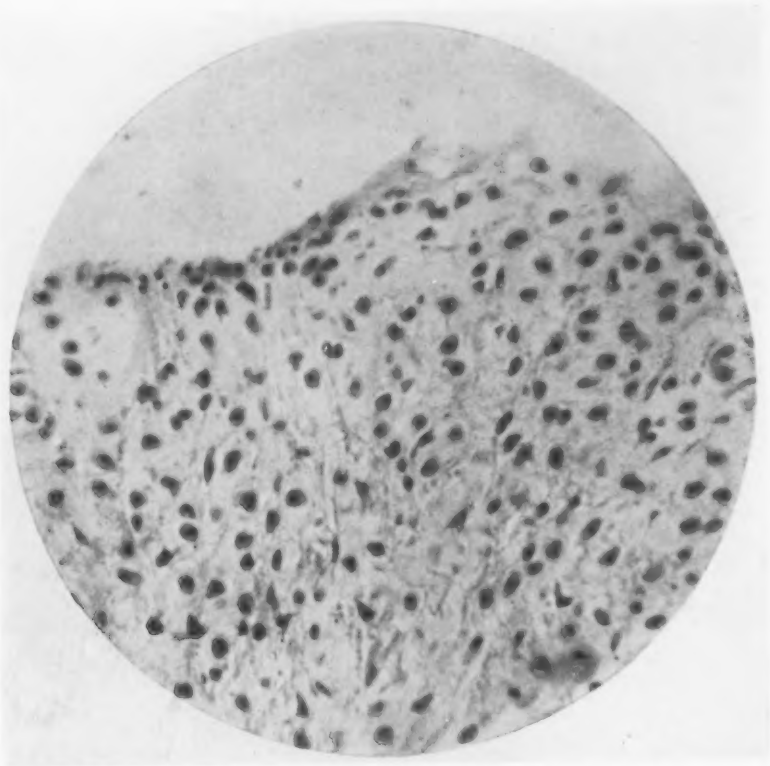


FIG. 2.—Case I (Pathol. No. 6773). Pure myxoma (high dry power).

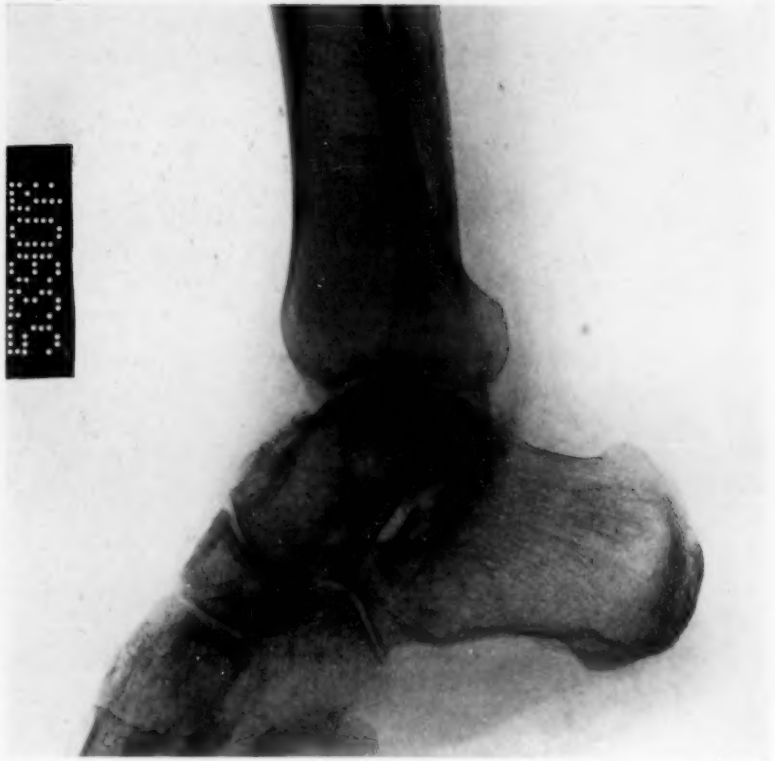


FIG. 3.—Case II (Pathol. No. 22929). Central myxoma of astragalus. X-ray before first operation.

FIG. 4.—Case II (Pathol. No. 22929). Photograph of pieces of astragalus removed at the first operation. The larger pieces are the bone shell, the smaller pieces the myxoma.

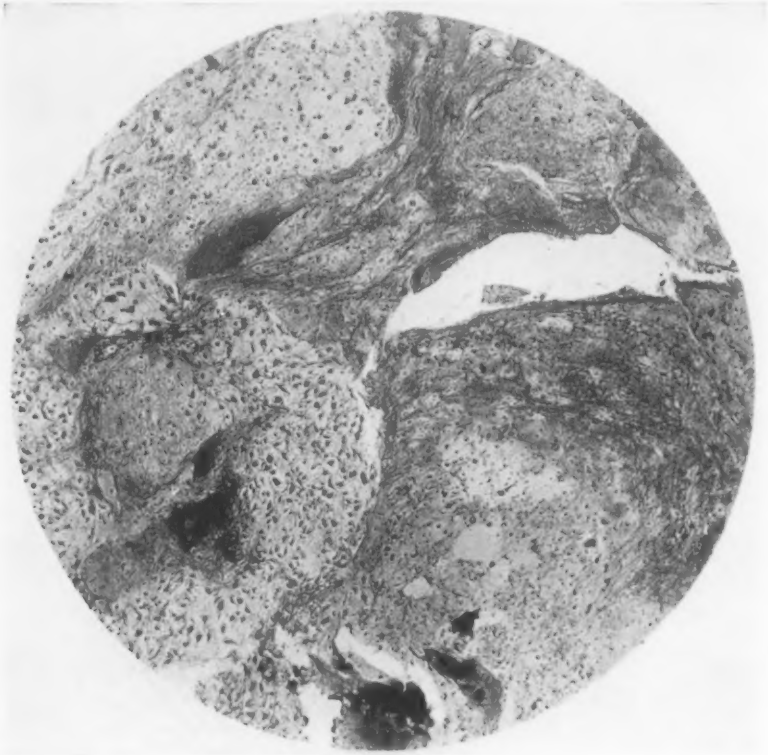


FIG. 5.—Case II (Pathol. No. 22929). Microscopic picture (low power) showing the pure myxoma, a few islands of bone, and the eosin-staining fibrous tissue which separates the myxomatous tissue into smaller and larger islands.

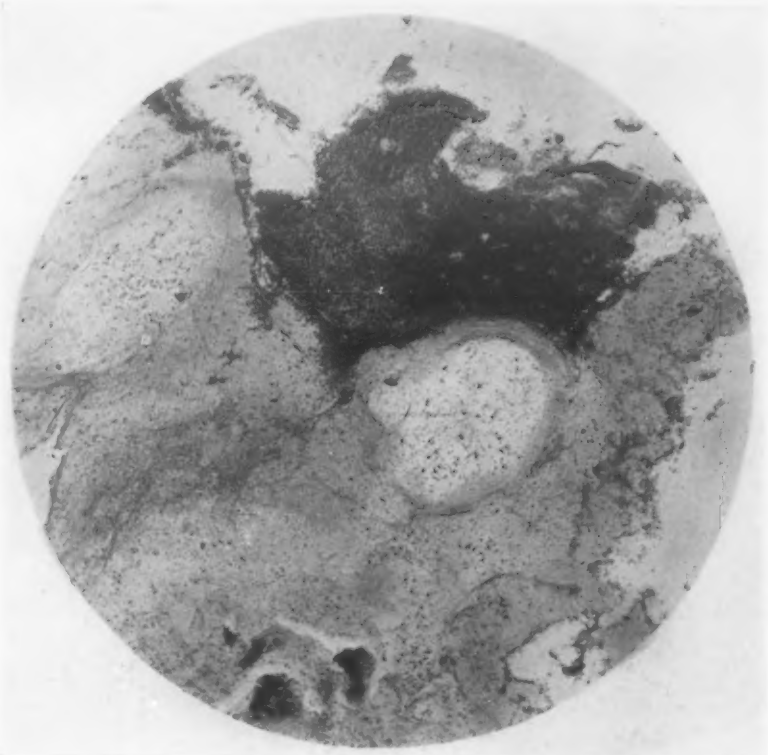


FIG. 6.—Case II (Pathol. No. 22929). Microscopic picture (low power) from another myxomatous area showing a cellular area. For the high power of this see Fig. 7.

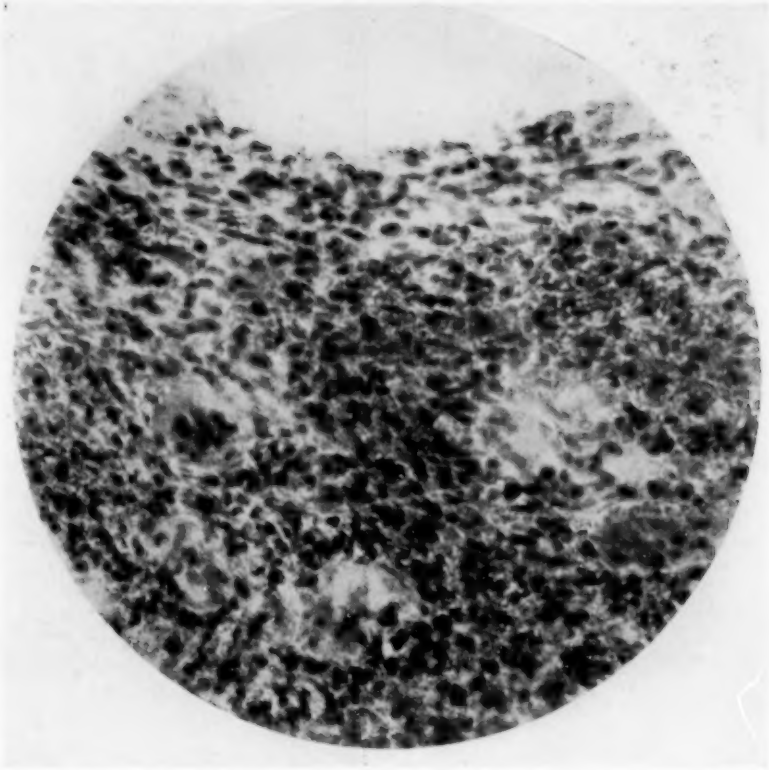


FIG. 7.—Case II (Pathol. No. 22929). Cellular area (high dry power) shown in Fig. 6. This shows giant-cells, cells resembling osteoblasts, and granulation tissue. Areas similar to this were not found in the first and second recurrent tumor.

currant-jelly areas. Here we see the same myxomatous tissue surrounding a cellular area. This cellular area (Fig. 7) contains giant-cells imbedded in stroma not unlike that of the giant-cell tumor. The first pathologist who examined these sections diagnosed the tumor as giant-cell, although he gave a clear description of the myxomatous area.

In January, 1919—about ten months after this operation, the patient returned to the first operator because of recurrence of the swelling and pain in the ankle and inability to walk without crutches. At that time an exploration was made, but no tumor tissue was sent to the laboratory.

Examination (April 5, 1919).—It is now one year since the first operation and about three months since the last incision. The region of the ankle is intensely swollen and œdematous. Below the position of both malleoli one can palpate what appears to be bulging tumor tissue. There is no œdema above the ankle and none of the toe.

The X-rays (Fig. 8), lateral and anteroposterior views, show that the astragalus has been removed and that there is some bone destruction of the articular surface of the tibia, but it does not picture the extent of the soft-part tumor.

Operation (April 10, 1919).—Amputation of lower third of leg without exploratory incision.

I performed this amputation because of my knowledge that the original tumor was a myxoma. I amputated in the lower third, because the X-ray of the shaft of the tibia showed no involvement above its articular surface.

Gross Pathology.—Fig. 9 is the outer surface of the dissected mass in the region of the ankle, and in the lower portion, corresponding to the area below the internal malleolus, I have made a section to picture the fresh appearance of the myxoma. You will note that it corresponds with the description of the first operator—myxomatous tissue with red currant-jelly areas. The tumor is confined by a distinct capsule.

Fig. 10 is a longitudinal section through the tibia and bones of the ankle. The myxomatous tumor with its current-jelly areas is seen to occupy the space of the astragalus and to extend in all directions around the lower end of the tibia. One will also observe that the articular surface of the tibia is partially destroyed and tumor tissue is invading the cancellous bone. Invasion of the os calcis and scaphoid is distinctly less.

The *microscopic appearance of this tumor tissue* is identical with that shown in Figs. 5, 6 and 7. The tumor had, therefore, not changed into a sarcoma.

Currant-Jelly Areas.—From my experience these small currant-jelly areas which usually contain giant-cells imbedded in very cellular stroma are not diagnostic. I have observed them in ostitis fibrosa, in the giant-cell tumor, in myxoma, and in chondroma. Their true significance is still unsettled.

Results.—Before this patient left the hospital X-rays were taken of the stump to ascertain again whether we had overlooked any possible involvement in the remaining shaft of the tibia or fibula. Careful inspection was negative. It is not out of place here to state that before my amputation X-rays were made of the chest and other bones also with negative findings. The urine contained no Bence-Jones bodies, and the blood was negative for Wassermann. There was no evidence of the patient's old polyarthritis.

In October, 1919, the patient returned because of pain and tenderness in the beak-shaped process of the tibia which he attributed to the pressure of the artificial limb. It is now six months since the amputation. An X-ray (Fig. 11) now shows an area of bone destruction in the tubercle of the tibia.

On October 14, 1919, I explored this area with the cautery, demonstrated the myxomatous tumor, removed it with the cautery with a good margin of cancellous bone and soft parts and packed the wound with a piece of gauze saturated with zinc chloride solution. Frozen sections showed a myxoma similar to that removed in the two previous operations.

The amputation above the condyles of the femur was not done until three days later, because until then the patient's consent could not be obtained.

At the present time (October, 1920), one year since operation, the patient is free from pain and walks well on his artificial limb.

Case III (Pathol. No. 10150). *Periosteal Exostosis of Lower Third of Shaft of Femur with Myxomatous Areas.*—In this case the large exostosis was removed piecemeal by a colleague in December, 1909. There was nothing in the clinical picture, in the X-ray, nor at the operation to suggest a malignant tumor. The microscopic diagnosis made in the laboratory was ***benign exostosis.***

Recently when I restudied some 110 cases of exostosis, this patient was the only one reported dead. We were informed that he died four years after operation with recurrence of the tumor in the region of the knee and symptoms of metastasis to the lung.

On reëxamination of the tissue in the laboratory I found definite areas of myxoma between the cancellous bone in this exostosis—a microscopic finding not present in any other case of this group.

Clinical History.—The patient is a white male aged fifty-five. There is no history of injury. Six years before operation he observed stiffness of the left knee, then a definite hard lump in the popliteal area, later some interference with flexion.

X-ray (Fig. 12).—This shows a large bony growth springing from the posterior surface of the lower third of the femur above the condyle. In some places it shows lighter areas. There is no definite change in the shaft of the bone. The appearance is that of a benign exostosis.

The *examination* was negative, except for the palpation of the tumor.

At the *operation* the tumor had a capsule and was composed

chiefly of bone. It was chiseled from the shaft of the femur, but no note was made of the condition of the shaft. The patient left the hospital in apparently good condition.

Gross Pathology.—The tissue received in the laboratory consists of two pieces of bone 2x3x5 cm. and fourteen smaller pieces. The surface of the tumor shows a connective-tissue capsule and what appears to be definite periosteum. Beneath this periosteum in places there is cartilage, in other places there is no cartilage. The tumor beneath is composed of rather soft cancellous bone which can be cut with the knife. In my experience this is unusual in the benign exostosis, and such a finding should be regarded as suspicious.

Microscopic Study.—The greater part of the tumor is composed of cancellous bone. The soft tissue between the bone lamellæ is the seat of an inflammatory reaction; lymphoid cells predominate; there are no giant-cells, but many osteoblasts. In a second section (Fig. 13) we observe the cartilage covering and the cancellous bone beneath, but here between the lamellæ of bone there is definite myxomatous tissue. Here and there, between the cartilage and bone, a giant-cell.

Fig. 14 is from an area in which the tissue between the bone lamellæ shows lymphoid-cell reaction. I am unable to interpret this picture—whether this is an inflammatory reaction, or young myxomatous tissue.

I think there can be no question that there is myxoma in this exostosis, and the recurrence and death four years later are pretty good evidence that the lesion was not a benign exostosis.

What would be our procedure in these cases to-day?

In Case I, the periosteal lesion of the shaft of the humerus, we could be quite positive that we were not dealing with a growth composed entirely of bone, because the centre contained no bone. The possibilities are: cartilage (chondroma), myxoma and a cyst. I have an example of each. In this case one could have removed the tumor without exposing the tumor tissue; the soft parts could have been divided down to the shaft of the bone, the periosteum divided some distance from the pedicle, and a piece of the shaft chiseled away giving the tumor a good margin. I would then swab the exposed chiseled bone with pure carbolic acid followed by alcohol, pack the wound with a piece of gauze saturated with a solution of zinc chloride. Then I would divide the removed tumor, make frozen sections of the centre, and study the zone of bone removed from beneath the tumor for possible infiltration.

Case IV (Pathol. No. 10693).—Fig. 15 is the X-ray of a tumor which somewhat resembled that in Case I (Fig. 1). I removed it after the method just described. Fig. 16 shows the result after operation, and Fig. 17 (*a* and *b*) the removed tumor, which proved to be a bone cyst

with a definite connective-tissue lining of ostitis fibrosa. This patient is well (July, 1920) ten years after operation.

In Case II, the central myxoma of the astragalus, I think it would be justifiable to try X-ray or radium first. If signs of ossification did not present themselves quickly, I should explore under an Esmarch with the Paquelin cautery. If it proved to be a bone cyst, I should curette, leave the bone shell, and close without drainage. If it were found to be a giant-cell tumor, I should curette thoroughly, swab with pure carbolic acid followed by alcohol and close without drainage. I have already noted that we have had examples of each one of these types who remained free from recurrence after curetting.

If the tumor proved to be an chondroma without myxomatous areas, I would employ the same method as for the giant-cell tumor, but use radium afterwards, placing the radium in the wound and closing later.

If the tumor proved to be a myxoma, I would curette with the cautery, followed by carbolic acid and alcohol; I then would pack the wound with zinc chloride gauze and leave it in for twenty-four hours. I would then close the wound and watch the case most carefully.

There is, however, no case to prove the efficacy of this treatment in myxoma, but as the myxoma recurs first locally, the amputation could be done later if there was a recurrence.

In the third case, the exostosis of the femur with myxomatous areas, I should attempt to remove the tumor as in Case I, without exposing tumor tissue. In this case, as in the majority of exostoses, the growth can be isolated and chiseled from the shaft without exposing tumor tissue. Should the exostosis be of such size that removal *en-bloc* would be impossible, I would advise immediate frozen sections of the soft areas, and if myxoma were found I should immediately employ the electric cautery and chemical cauterization.

As I have noted before, one will frequently find in exostosis cartilage, and in the cartilage there may be soft areas which resemble in the gross myxomatous tissue. The differentiation can be made only in the frozen section.

I have recently had such an observation in an exostosis composed largely of cartilage in which there were soft gelatinous areas suggesting myxoma.

I emphasize again here the possibility of implanting even cartilage in a piecemeal operation. For this reason chemical destruction or the cautery should be employed as a means to prevent recurrence. I have a case to prove the point: The original tumor was apparently a cartilaginous exostosis of a metacarpal bone; it was first removed with a knife by a colleague; the tumor recurred. I then exposed and removed the recurrent tumor with the cautery, preserving part of the metacarpal bone. Before operation I was rather inclined to the view that it was

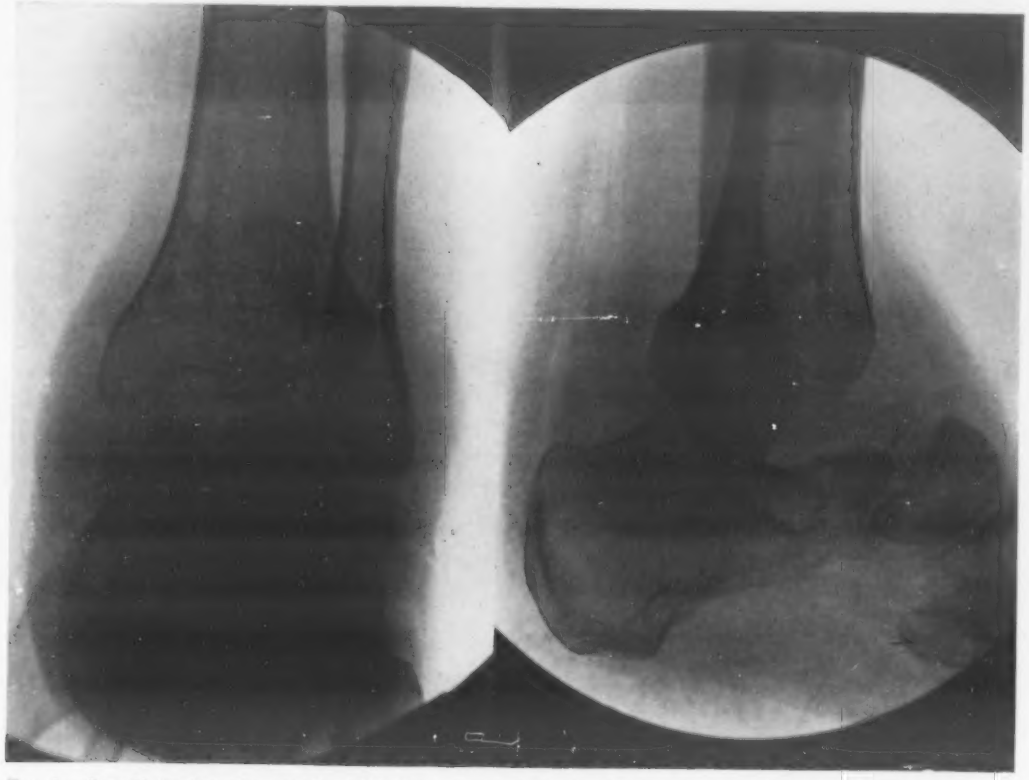


FIG. 8.—Case II (Pathol. No. 24346). (Old No. 22929). X-ray showing recurrence with destruction of the articular surface of the tibia after the removal of the central myxoma of the astragalus piecemeal.

FIG. 9.—Case II (Pathol. No. 24346). (22929.) Photograph of the dissected specimen after amputation. In the lower mid-area a cut has been made exposing the myxomatous tumor. The light lobular areas are characteristic of myxoma; the red currant-jelly areas have been observed not only in this tumor, but in ostitis fibrosa, and they predominate in the giant-cell tumors.

FIG. 10.—Case II (Pathol. No. 24346). (22929.) Photograph of longitudinal section through ankle-joint, showing the recurrent myxoma surrounding and invading the lower end of the tibia.

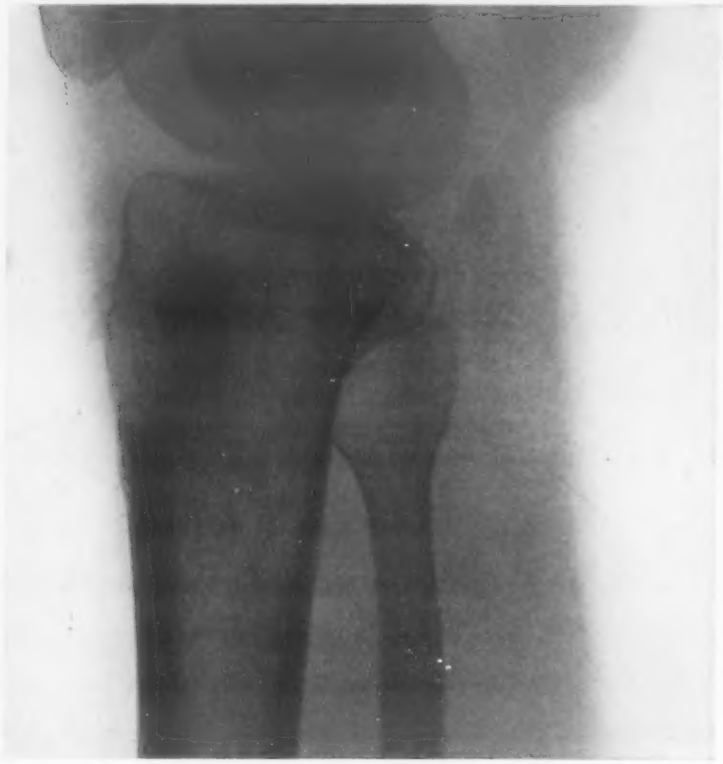


FIG. 11.—Case II (Pathol. No. 24346.) (22029). X-ray of recurrent metastatic myxoma in tubercle of tibia after amputation of leg for recurrent myxoma in ankle-joint. Microscopic picture similar to that shown in Figs. 2 and 5.

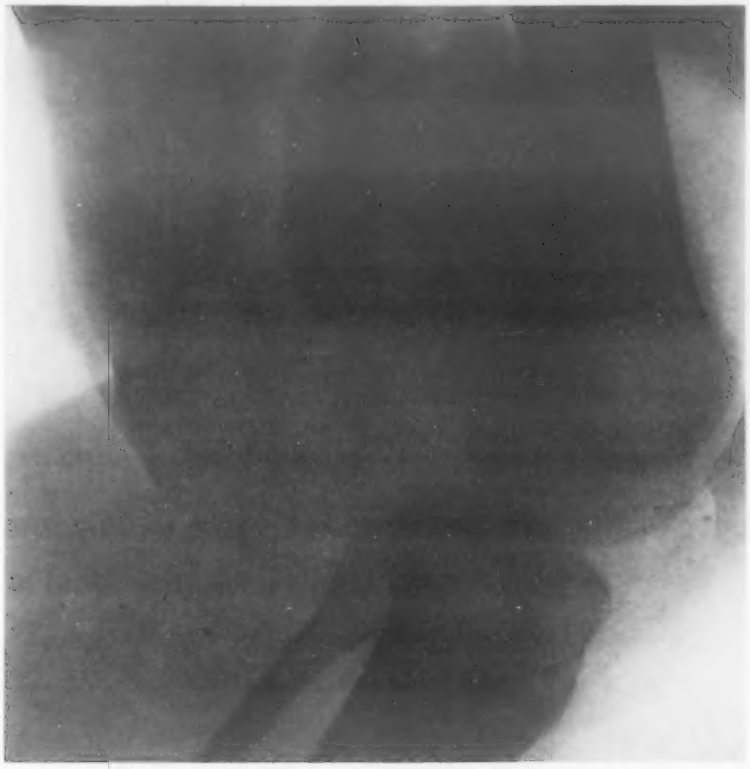


FIG. 12.—Case III (Pathol. No. 10150). Exostosis. The X-ray shows chiefly bone with some light areas. See Figs. 13 and 14 for microscopic picture.

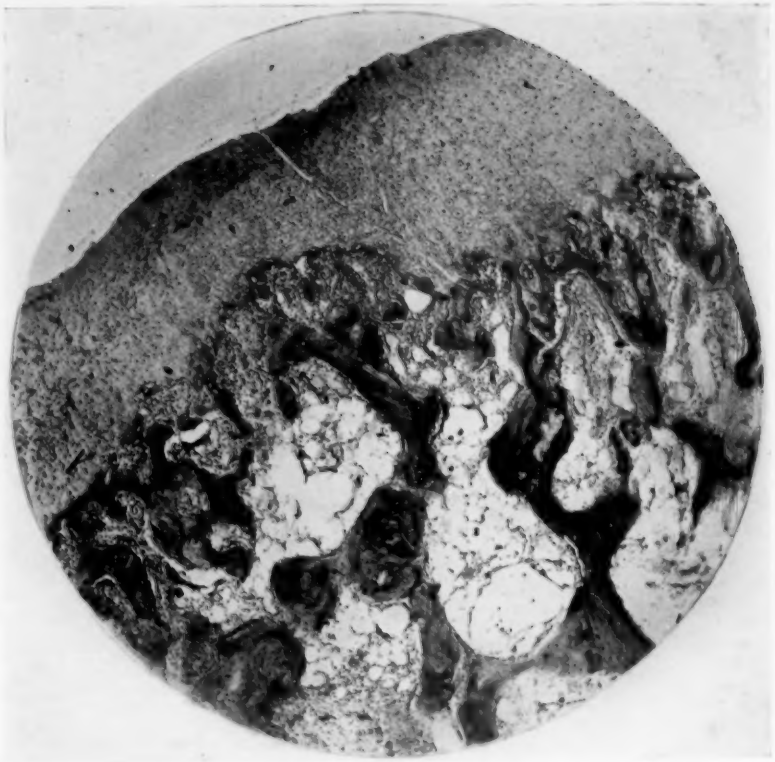


FIG. 13.—Case III (Pathol. No. 10150). Microscopic picture (low power) to show the cartilage capsule of the exostosis, the bone lamellæ of its framework, the medullary tissue and myxoma between the bone lamellæ.

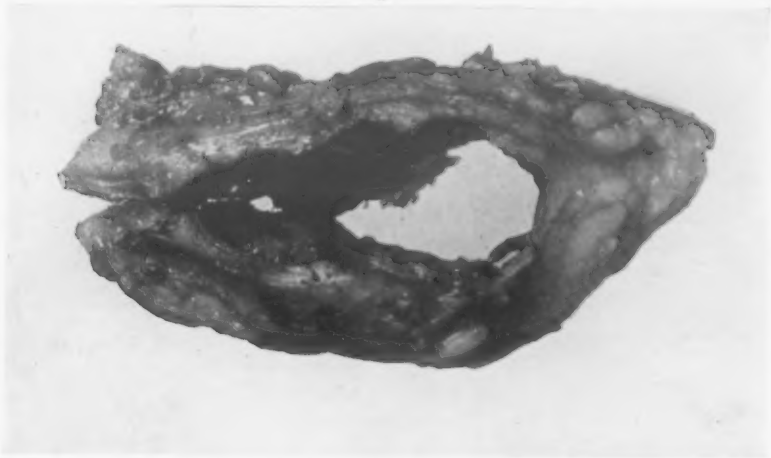
FIG. 14.—Case III (Pathol. No. 10150). Bone lamellæ with young lymphoid tissue filling up the spaces between the bones, suggesting young myxomatous tissue.

FIG. 15.

FIG. 16.

FIG. 15 AND 16.—Case IV (Pathol. No. 10693). X-ray of a benign bone cyst before and after operation. Compare this with X-ray shown in Fig. 1, a pure myxoma.

a



b

FIG. 17.—Case IV (Pathol. No. 10693). Photograph of gross specimen of the benign bone cyst shown in Fig. 15. This cyst was lined by a membrane of ostitis fibrosa; no myxomatous tissue.

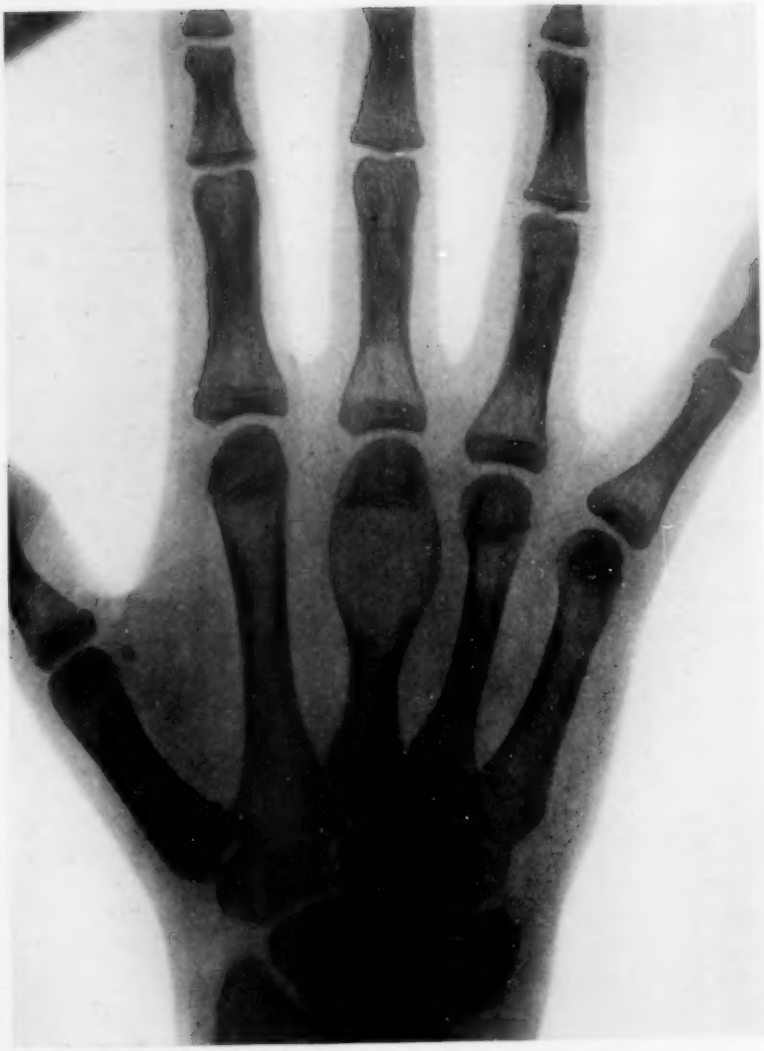


FIG. 18.—Case V (Pathol. No. 14552). Central myxoma of metacarpal bone. X-ray and tissue sent me by Doctor Kimpton of Boston. Compare this X-ray with Figs. 1, 3, 11 and 15.

a periosteal myxoma because of the recurrence, but the sections showed only cartilage. This patient is now well for a longer interval after the second operation than after the first.

BRIEF SUMMARY OF MYXOMA AND CHONDROMYXOMA OF BONE

Among about 270 bone tumors which I have studied, 12 may be classed as myxoma; 9 of these are pure myxomas, and 3 are chondromyxomas. Of the pure myxomas, 2 were periosteal tumors and 7 central. Of the chondromyxomas, 1 was periosteal, 2 central. The myxoma, therefore, is more frequently a central tumor of bone.

The combination of myxoma and cartilage is relatively infrequent—only 3 examples of chondromyxoma as compared with 14 pure chondromas, 7 periosteal and 7 central.

Nevertheless, when one exposes a tumor resembling cartilage there is always a possibility of myxoma, and its presence should be determined at once by a frozen section.

Results in Myxoma and Myxochondroma.—Three cases are apparently cured. At the operation in each instance the tumor was not exposed. In one a central myxochondroma of the humerus was removed by amputation at the shoulder-joint (Johns Hopkins Hospital, 1894), and this patient died thirteen years later at the age of eighty-three of other causes. In the remaining two cases the tumor was a pure myxoma, involving the central cavity of a phalanx; in one, the lesion was removed by amputation (by Rhodes, Roanoke, Va.), in the other by resection (Codman, *Boston Med. and Surg. Jour.*, Feb. 25, 1904). These patients have been followed only two and three years respectively.

Unfortunately, for scientific purposes, the two examples of central myxoma of the phalanx of the finger subjected to curetting only, were not followed by the operators.

Up to the present time there is not a single case of myxoma or myxochondroma which has remained well and free from recurrence after an operation consisting of curetting only.

In addition to the three cases reported here, one of which recurred after curetting and the remaining two after piecemeal operations, there are two other cases which recurred and were subjected to second operations, and which at the present time are apparently well. This would make three cases of myxoma which have been apparently cured in spite of recurrence: *viz.*: the following:

Case II, reported here (Pathol. No. 22929), well October, 1920, one year since the last operation, amputation of the femur for a recurrence in the upper end of the tibia.

Pathol. No. 14552, Central Myxoma of Shaft of Metacarpal Bone (Fig. 18). In this case, in May, 1912, Doctor Kimpton, of Boston, removed the tumor by resection, but he is of the opinion that during the resection tumor tissue was exposed and that some of it may have been left in the wound. On account of recurrence

he operated again one year later, and this patient was free from recurrence two years after the second operation. I have studied the sections in this case, and it is an example of pure myxoma. The patient at the time of operation was fifteen years of age; the central tumor was found accidentally in taking an X-ray because of a recent injury, and this showed both a fracture and the tumor. The X-ray shown in Fig. 18 was taken one year later and illustrates that if there had been a fracture it has healed, and there is no evidence that myxomatous tissue infiltrated outside through the crevice of the fracture. I have been unable to get the first X-ray, but this is a very interesting observation, demonstrating that the fracture may heal even if the central tumor is a myxoma.

Pathol. No. 19545. Central Myxochondroma of the Os Calcis.—I have recently restudied the section in this case. There is chiefly cartilage, with small islands of myxoma in the cartilage. When this patient was admitted to Johns Hopkins Hospital in 1916 he was twenty-three years of age; there had been pain in the os calcis for one year; there had also been an operation on the os calcis three months ago, but apparently the operator did not expose the disease in the centre of the bone. The X-ray diagnosis was ostitis and periostitis of the os calcis. Doctor Dandy, who operated, describes a small opening in the bone from which there exuded gelatinous material. This at once would suggest myxoma, although in some instances softened cartilage may also produce this gelatinous material. On removing a shell of bone there was exposed a cavity, the size of a lemon, filled with tissue resembling cartilage, with here and there gelatinous, myxomatous areas and a few areas resembling the giant-cell tumor. After thoroughly curetting, Doctor Dandy disinfected with carbolic and alcohol. There was local recurrence followed by amputation one year later, and the patient was reported well two years later (September, 1919).

Here the pure carbolic and alcohol did not prevent recurrence. From a study of the sections of the bony shell I am confident that in this case the entire shell is infiltrated with myxoma, so that the disease was not completely removed.

Five patients are dead: Cases I and III, already reported here, and the following:

Pathol. No. 2331.—Here the myxoma was periosteal, involving the sacrum and the lower lumbar vertebræ, with infiltration of the soft parts. At the exploratory operation the tumor could not be removed. The patient died five months later.

Pathol. No. 8475.—Central Myxoma of the Shaft of the Humerus.—Here curetting was done, as the patient refused amputation. There followed a local recurrence in seven months and death from the disease in four years.

Pathol. No. 18554.—This case is of interest chiefly because it was a small periosteal tumor springing from the body of the seventh dorsal vertebra and bringing the patient under observation because of pressure on the spinal cord. The tumor was the size of a ten-cent piece and was composed chiefly of cartilage, with myxomatous areas. The patient died ten months after operation. The pressure symptoms were not relieved. The question as to recurrence could not be decided.

Literature on Myxoma of Bone.—In 1904 (*Progressive Medicine*, December, 1904, p. 185), in the discussion of bone cysts due to ostitis fibrosa, I reviewed the case reported by Codman (*Boston Med. and Surg. Jour.*, Feb. 25, 1904, p. 211). The tumor was central in the second phalanx of a finger, Codman reported this case as the only cyst in that situation. Doctor Whitney, the pathologist, was of the opinion from

the gross appearance that it was a myxochondroma, but unfortunately the sections have been lost. The probabilities are that this was either a myxoma or a chondroma.

In describing the gross appearance of the tumor after resection, Doctor Codman writes that within the bone shell there was a small cavity, and between the bone shell and the cavity fine trabeculæ lined with soft myxomatous tissue.

In ANNALS OF SURGERY (vol. lii, August, 1910, p. 150) I isolate from bone cysts due to ostitis fibrosa in which the central lesion was composed of myxomatous tissue. At that time I had Codman's case, one case sent to my laboratory by my colleague Doctor Baer, and three cases from the literature (Dreesmann, Blake and Bostrom, for references, see my article just quoted). Since then I have in my own collection up to date, ten cases of central lesions of the phalanx of the finger, five of which are myxomas and three chondromas. There is therefore up to the present time no reported case of ostitis fibrosa of the phalanx of the finger in which the diagnosis has been confirmed by a microscopic study of the lining of the cyst.

In *Progressive Medicine* (December, 1906, p. 221) I reviewed the first article on pure myxoma of bone which had come under my attention. Soubeyran (*Revue de Chir.*, 1904, xxix, p. 239) in reporting his single observation gives but six references to the literature. The case reported by this surgeon was apparently a periosteal growth from the lower third to the shaft of the tibia. The mass was 8 cm. long and 2 cm. wide. At the exploratory operation after dividing a connective-tissue capsule in which in places there was thin shell of bone, there exuded a gelatinous material, and this material was confined to a space circumscribed by this capsule and shell of bone in the shaft of the tibia. Between the gelatinous material there were small spicules of bone. The treatment was curetting. In a few months there was recurrence, and at the second operation cortical bone was chiseled away with the recurrent tumor. One year after operation there was no recurrence.

Soubeyran makes this interesting remark: "In these myxomas there is no definite line of demarcation." I infer that he means that the myxomatous tissue may infiltrate the cortical bone without sufficient bone destruction to be seen either in the X-ray or in the fresh tissue. This is an important point to remember when dealing with myxoma. In spite of this, Soubeyran advocates conservative methods.

In the same number of *Progressive Medicine* I reported for the first time Case I (Pathol. No. 6773) described in this paper.

It is interesting to note in confirmation of Soubeyran's remarks that I have just reëxamined a bit of the bone shell removed with the chisel beneath the periosteal myxomatous growth in Pathol. No. 6773 and find it infiltrated with myxomatous tissue without much bone absorption.

Up to the end of 1914, the literature on bone tumors was most care-

fully followed without finding any references to this rare lesion. Within the past year William H. Fisher, of Toledo (ANNALS OF SURGERY, 1919, vol. lxix, p. 596) makes a most interesting contribution to pure myxoma, but his tumor involved the soft parts of the labium majus. He gives a very interesting summary of the views of pathologists up to date on myxoma, but does not discuss myxoma of bone. He refers to the case of pure myxoma of the phalanx reported by me and to one reported by Cotton (*Amer. Jour. of Röntgenology*, 1918) in which the myxomatous tumor involved the whole shaft of the femur from neck to condyles.

The best description of myxoma from a histological standpoint is in Ewing's recent book ("Neoplastic Diseases," 1919, p. 166), but he does not mention myxoma of bone.

In the excellent article on Bone Tumors written by Channing Simmons of Boston, for the "American Practice of Surgery" by Bryant and Buck in 1907, (vol. 888, p. 394) myxomas of bone are not mentioned, nor are they referred to in a short article on bone tumors by Nichols of Boston in 1907 ("Keen's Surgery," vol. II).

Referring back to Senn in 1895, we find no mention of myxoma of bone in his book on the "Pathology and Surgical Treatment of Tumors." The chapter on pure myxoma, about eight pages, does not mention this tumor as involving bone. This is good evidence of the rarity of the lesion, because he was most familiar with surgical literature, especially on tumors.

HYPOPHYSEAL DUCT TUMORS

A REPORT OF THREE CASES AND A FOURTH CASE OF CYST OF RATHKE'S POUCH

By William C. Duffy, M.D.
of New Haven, Conn.
Assistant in Surgical Pathology, Department of Surgery, Yale University

(*Continued from page 552*)

The following case *intra vitam* was briefly referred to from the röntgenographic viewpoint by Heuer and Dandy (Case IV) in 1916 in their study of röntgenography in the localization of brain tumor.

Case III.—*Suprasellar cystic squamous epithelial tumor of infundibulum, with metaplastic and extensive degenerative changes, developing from an inclusion of the hypophyseal duct. Bitemporal hemianopsia. General pressure and neighborhood symptoms for two years. Amenorrhœa (the first symptom) for three years with increase in weight (dystrophia adiposo-genitalis); atrophy of endometrium. Calcified area above sella (X-ray). Lateral intracranial operation with temporary relief. Exitus subsequent to second operation. Autopsy.*

Abstract of J. H. H. (Surgical Histories Nos. 32604 and 34653). A young white woman, twenty years old, was transferred from the medical to the surgical service May 25, 1914, *complaining* of blindness (on account of which she had previously been admitted to the medical service). Her family history was negative. She was the wife of a farmer to whom she had been married for a year and a half. Beginning at twelve years of age she had suffered with poor general health and occasional headaches. At fourteen years of age there was a severe attack of tonsillitis, and about a year later a slight attack of catarrhal jaundice lasting a week. Her menstrual periods, at first regular, after lengthening intervals, gradually ceased three years ago. At that time she weighed 100 pounds. Since then her weight has rapidly increased to 130 pounds. *Two years ago* she had her first episode of severe nocturnal headache, lasting a few minutes, followed next day by partial right-sided hemianopsia with dimness of vision persisting for two days. There was no other attack until eight months ago, when a more severe attack occurred. Sick in bed; headache with roaring in ears and spots before eyes. At the end of one week she was unable to count fingers held before her eyes. Flashes of color and imaginary objects were seen. Vomited once. Dimness of vision for three weeks, thence normal; polyuria and dysuria one week. Polydipsia. Rapid improvement. The last attack occurred two months before admission. There was gradually increasing dimness of vision in both eyes for two weeks, followed by severe headache with tinnitus. *En route* to another clinic she vomited once, but attributed this to "car sickness." The severe headache continued for one week. The diagnosis of tumor near the

optic chiasm was made, and X-ray treatment was employed for three weeks without benefit. From time to time the vision seems better, then worse again, and so on until admission here.

Examination.—A rather juvenile looking young woman, rather well nourished. Axillary and pubic hair a little less than normal. Head: Normal in appearance. Eyes: Left eye does not converge, vision dim in both eyes, almost *nil* on left, right 16/100, counts fingers at three feet. Nose: Negative. General neurological examination: Negative. No general glandular or thyroid enlargement. Thorax, heart, and abdomen negative.

Blood examination: Red blood count, 4,300,000; white blood count, 8000; hæmoglobin, 85 per cent.

Wassermann: Negative.

Urine: Sp. gr. 1005–1012, no sugar or albumin.

Carbohydrate tolerance: After taking 200 grams of glucose no glycosuria in subsequent twenty-four hours.

FIG. 13.—Case III. X-ray of sellar region showing suprasellar calcified mass at *C*. The sella itself is not enlarged and the cavity of the sphenoid not encroached upon.

Ophthalmoscopic: Post-neurotic atrophy, more advanced on left.

X-ray report: No. 23351 (Dr. F. H. Baetjer).

Small calcified area in top of sella (Fig. 13).

Transferred to surgical service for operation.

Operation (May 28, 1914, Dr. G. J. Heuer).—*Evacuation of interpeduncular cyst through lateral approach (left) originated by the operator.* A cyst was evacuated which filled the region of the chiasm and apparently involved the sheath of the optic nerve. On opening it about an ounce or more of brownish fluid was obtained. The hypophysis itself was not seen at any time. Usual closure.

Uneventful recovery from operation. On July 22, 1914, she wrote: "Enjoying best of health. No change in vision" (or amenorrhœa).

Second Admission.—March 22, 1915.

Present Illness.—The patient was well for three months after discharge from the hospital nine months ago. Then she noticed vision was becoming dimmer. Now she cannot read the largest print and is only able to recognize familiar persons within a range of three feet. She has put on considerable fat since last operation. Appetite good, is always hungry, likes vegetables, especially. Does not care for sweets. No other symptoms—no headaches, vomiting, change in mentality or irritability. No relief of amenorrhœa; she has not menstruated in four years. Does not void unusual amounts. Occasional nycturia.

Examination.—A very well-nourished young woman, skin somewhat dry, subcutaneous layer everywhere rather thick and shows

slight painful sensitiveness to pressure. Hands, wrists, feet and ankles small. Fingers tapering. Temperature, 99°. Pulse, 92.

Fundi: Bitemporal hemianopsia.

Operation (March 27, 1915, Doctor Heuer).—*Evacuation of infundibular cyst.* (At the previous operation the left side was operated on.)

A large flap was turned back on the right. The interchiasmal space was filled with a cystic tumor having the same appearance as at first operation. The cyst was opened with a knife over the left optic tract, producing a "gush of yellowish-white fluid with most beautiful shimmering golden crystals. They were found to be cholesterin crystals. At first they were taken for minute globules of fat." Probably 1 or 1½ ounces of fluid escaped.

"At this time looking still farther back a second cyst with translucent wall was evident." Passing a clamp into this a gush of fluid even larger in amount than the first occurred, which contained similar substances. This fluid in a test-tube was of a yellowish-brown color and quite turbid. It was felt that the direction of this second cyst was both upward and downward, into the third ventricle and into the chiasm. In attempting to remove the lining of the cyst a considerable amount of hemorrhage occurred. As soon as this was controlled by silver clips on the anterior communicating cerebral artery, closure of the wound was made.

The patient succumbed twelve hours after operation. Temperature reached 106°.

Autopsy.—No. 4315. (Dr. Thornton Stearns.)

Anatomical Diagnosis.—Parahypophyseal cyst, arising from Rathke's pouch.

Body.—Is that of a young, very well nourished and well-developed white woman. Head has been entirely shaved, and there is a surgical wound on the right side extending from behind the ear almost to the sagittal median line, forward down on the forehead and extending down to the outer edge of the right orbit. The recent incision is in excellent condition. On the opposite side is a similar but well-healed linear scar.

The body was that of a fairly well-developed female. There is a good deal of fat throughout the body. The breasts are not very large and are not well developed. The hair in the axillæ and over the pubis is present, but not of luxuriant growth; otherwise there are no external abnormalities.

Partial autopsy was obtained, median section through the abdomen, through which the pelvic organs were examined, and the uterus, tubes and ovaries were removed. The uterus was small, was retroverted and retroflexed; the ovaries were small and the tubes were perfectly normal. On cutting into the uterus it showed a normal cavity with some mucus in it. The *adrenals* were removed and were both perfectly normal, showing a brownish centre, with a yellowish-white cortex. They were of normal size.

Brain.—After formalin fixation *in situ* was removed in the usual manner. The surface of the hemispheres showed slight flattening of the convolutions. The hypophyseal region, which was removed by Doctor Heuer, showed a small amount of bloody ooze of the operation two days ago. The floor of the cranial cavity was normal.

The sella turcica was normal and the hypophysis located in a per-

fectly normal manner, and on being removed was found to be of normal size. The infundibulum of the hypophysis was not seen and was thought to be involved in the tumor mass. Situated at the base of the brain in the interpeduncular region was the remains of the cyst which was opened and partly removed at operation. After sagittal hemisection of the brain the cyst wall is seen to involve the suprasellar (infundibular) region and the lower part of the third ventricle.

The brain was cut sagittally. It showed a cyst occupying the lower portion of the third ventricle. The wall of the cyst was quite thin, about 1 mm. in thickness. It was rather rough and granular on its inner surface. Small yellow granules which appear to be calcified were present. These were probably little crystals of cholesterin.

At the base of the cyst there was a crystallized granular mass about the size of a pea. On being cut through it was very hard, cartilaginous

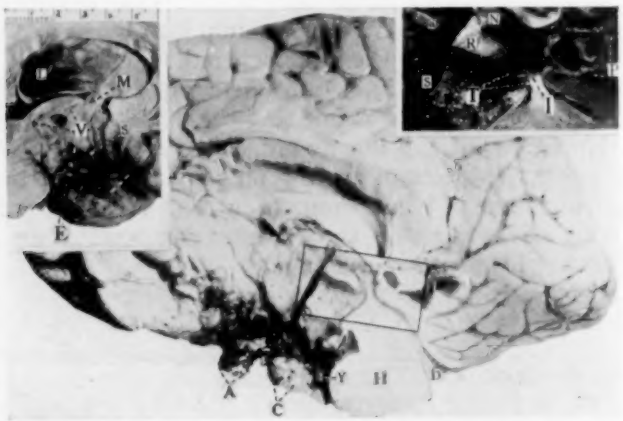


FIG. 14.—Case III. The central photograph of the mesial surface of the right half of the brain shows the calcified mass (*C*) which produced the shadow in the X-ray. At *A* is a second mass of tumor tissue. The squared area is shown enlarged in the right upper insert. The cystic tumor has extended above, displacing the floor of the third ventricle (*R*) upward, almost obliterating the space of the ventricle, which is reduced to the area between *R* and *N*. Posteriorly the wall of the cyst (*T*) has encroached upon the aqueduct of Sylvius (*I*). Anteriorly the floor of the third ventricle becomes deficient at (*A*). In the left half of the brain (left upper insert) the wall (*V*) of the cyst is deficient above and the widely dilated foramen of Monro (*M*) is seen leading into the dilated lateral ventricle (*L*). The extent of solid tumor (most of which has been removed) is shown at *E*. Blocks taken at *S*. *P*=pineal. *H*=pons. *D*=fourth ventricle. (*V*)=basilar artery.

almost, but was probably made up of the same crystals. They were of yellowish color. There was some blood clot present here. There was no very definite tumor tissue seen anywhere.

Further Description and Microscopic Study by the Writer.—The roof of the cyst has been displaced upwards and corresponds with the floor (Fig. 14, *a*, *R*) of the third ventricle. The cavity of the latter is clearly separate from the cyst cavity and is continuous with the space of the aqueduct of Sylvius (Fig. 14, *I*). The foramen of Monro (Fig. 14, *M*) is present on each side, and the moderate dilatation of the lateral ventricles is probably accounted for by pressure of the distended cyst wall posteriorly (Fig. 14, *T*) upon the aqueduct. The cyst measures 3.4 cm. anteriorly. Its vertical measurement is difficult to estimate on account of the destruction of much of the base of the cyst. The upper part of the cyst wall is about 1 mm. thick, the lower much thicker. In addition to the larger masses of tissue at the base smaller yellow granules are present higher up.

The masses of material at the base of the cyst constitute the major residuum of tumor tissue. They are blood-stained a slate brown color, but on section, or after removing clotted blood, show yellowish to chalky areas, which blend with light yellow to orange-colored zones, resulting in a marbled effect. The chalky areas are the result of calcium salts deposit or bone formation. On cutting through this partly decalcified tissue a gritty sensation is felt. In the protocol these masses were attributed to the presence of cholesterin crystals.

Blocks for microscopic study included ones: through the upper limit of cyst wall and adjacent third ventricle wall, the above-mentioned granular or yellow plaque areas; and the larger masses of tissue, containing calcified material which project into the cyst cavity lower down at the base of the tumor mass. In addition the sections made at the time of the autopsy (Doctor Stearns) are available.

Microscopic Examination.—The cyst wall is composed of a varyingly thick fibrous wall carrying a lining of squamous epithelium, which shows certain interesting hyperplastic, metaplastic and degenerative phenomena.

FIG. 15.—Case III. The left upper insert shows the gross block of tissue which is composed of a fragment (*E*) of the roof of the cyst extending high into the space of the third ventricle. At *P* is seen a tuft of choroid plexus. The central cut is a low power photomicrograph of the same tissue. At *E* the squamous epithelial lining may be seen, but is shown more distinctly in the lower insert which is a slightly higher magnification. *F* = fibrous wall of the cyst. *N* = nervous tissue.

The simpler structure of the cyst wall is seen where the roof of the cyst bulged upward into the space of the third ventricle. A block (Fig. 15, upper insert) taken through the upper extremity of the right lateral half of the cyst wall, underlying brain substances, and adjacent choroid plexus (Fig. 15, *P*) of the third ventricle shows at the lower part of the section, extending upward into the third ventricle, a segment of the roof of the cyst composed of squamous epithelium (Fig. 15, *E*), underlaid by fairly dense fibrous tissue. Beneath the latter lies brain tissue (Fig. 15, *N*), to which the fibrous wall is adherent. The intermediate zone shows a slight proliferation of neuroglial elements, which bind the tumor wall to brain substance. Between the two are several small cyst-like spaces, with a lining of one layer of flattened or cuboidal epithelial cells closely resembling the ependymal cells lining the third ventricle above. These cystic spaces apparently were formed from ependymal cells isolated during the fusion of the cyst wall with the wall of the ventricle. This intimate relation between brain substance and tumor wall is present only in a small area, above which the union becomes interrupted progressively, until finally the tip of epithelial-covered fibrous wall is seen projecting free into the cavity of the ventricle. Beneath this tip of cyst wall which lies free, the ependymal lining of the ventricle extends downward until the zone of adhesion between cyst wall and brain substance is reached. This squamous epithelial-lined process tapers toward its upper extremity, and near the tip of the latter one sees villous-like branches of choroid plexus (Fig. 15, *P*). The epithelium covering this extension of the cyst wall is atypical squamous epithelium, with a well-preserved cylindrical basal layer; intercellular bridges are present, but there is no horny layer.

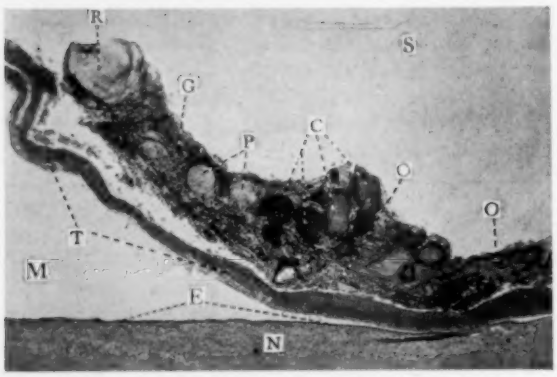


FIG. 16.—Case III. Lower-power magnification of a similar area which shows a segment of the roof of the cyst curving away from the ependymal (*E*) lining of the brain substance (*N*). The epithelium covering the fibrous wall (*T*) has undergone degenerative changes. At *P* one sees epithelial pearls. Calcified masses of keratinized stratified epithelium at *C*. Necrotic mass of epithelium at (*R*). Extensive round cell infiltration at (*O*). The cyst cavity=*S*. The third ventricle cavity=*M*. At *G*, under a higher-power foreign body giant cell reaction could be seen about disintegrating necrotic fragments of epithelium.

Its cells show rather marked reticulation, apparently a hydropic change, which will be referred to more fully below. For the most part, this stratified epithelium is composed of only a few layers; in places down-extending processes are present. Beneath the epithelium in such regions are atypical epithelial pearls composed of pink-staining keratinized cells, one of which is isolated in the fibrous tissue at a depth of .4 mm. below the squamous epithelial zone. The underlying brain substance shows no obvious changes. The choroid plexus present in this section is normal and there are no hyperplastic changes in the ependymal epithelium.

Sections of a block from a similar locality taken vertically through the upper limit of cyst wall and wall of third ventricle, show again the overhanging roof (Fig. 16) of the cyst, which is also lined on its surface bordering the cyst cavity (Fig. 16, *S*) with squamous epithelium. The adjacent ependymal lining (Fig. 16, *E*) of the third ventricle is even better preserved, the zone of separation between brain substance and overlying tumor wall is sharp in this preparation, no small ependymal cysts such as are mentioned in the preceding block are present. The epithelium covering this portion of the cyst wall, which in the gross had the appearance of a yellow, slightly raised, granular patch, shows interesting histological changes, however. Numerous necrotic, keratinized, concentric, epithelial cell nests (Fig. 16, *P*) are present, and several of these show marked peripheral calcification (Fig. 16, *C*). At the base of the section where the tumor wall is attached to the underlying brain substance the squamous epithelium is in places thinned

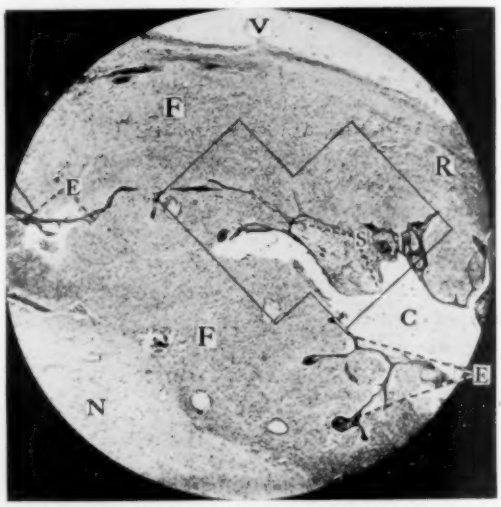


FIG. 17.—Case III. Lower-power photomicrograph of section through wall of cyst high up where the fibrous wall (*F*) is reflected to form the roof (*R*) of the cyst. The squamous epithelial lining (*E*) of the cyst sends processes into the fibrous zone. Note the epithelial area (*S*) projecting into the cyst cavity (*C*). *V*=cavity of third ventricle; the roof of the cyst is devoid of ependymal covering (*cf.* Fig. 16, *E*). *N*=cerebral nervous tissue.

to only a few cell layers. There is a slight reticulation of the epithelial cells in a few areas. A very marked lymphoid infiltration (Fig. 16, *O*) is present toward the tip of the process, which has broken up the epithelial continuity. Here there is a tendency to invasion by granulation tissue from beneath the epithelial zone. Nearer the tip the epithelium has lost entirely its regular appearance. Its stratification has disappeared and the individual cells are irregular in size, shape, and staining affinities, resulting in a slight hyperplastic picture. No mitoses are seen. In this area, particularly about the peripheries of the calcified epithelial processes, occasional small foreign-body giant cells are present. A moderate number of polymorphonuclear leucocytes are present in the areas of lymphoid infiltration and epithelial hyperplasia, and at the extreme tip, scattered through the necrotic hyalinized mass (Fig. 16, *R*), which has lost practically all traces of the outlines of its original epithelial cells.

Sections of another block show the cyst wall (Fig. 17, *F*) partly underlaid by adherent, but sharply demarcated, brain substance (Fig. 17, *N*). Near one end of the section the fibrous wall is sharply kinked on itself to form the roof (Fig. 17, *R*) of the cyst (Fig. 17, *C*). Close to the angle of the kink the epithelial surface shows an island of epithelium (Fig. 17, *S*) composed of large clear cells, with dark staining, comparatively small, irregularly polyhedral nuclei. The almost clear, but faintly staining, apparently lipoid, cytoplasm of these cells contains a delicate net-like reticulum (Fig. 18, *S*). Morphologically they resemble sebaceous-gland epithelial cells. The periphery of this area is partly outlined by a double layer of flat or cubical epithelium (Fig. 18, *L*), but on one side several epithelial pearls (Fig. 18, *P*) are present, the apex of this zone showing a curious excavation (apparently artifact) of a mass of hyaline necrotic epithelium. A second smaller area of this lipoid epithelium is present in the same section, and in sections from another block a third is found which is less sharply demarcated and less well preserved. Shaft-like clear spaces within the area evidence the formation of cholesterin crystals, which have been dissolved out. Between the lipoid epithelium and the lining epithelium is a dense zone of lymphoid infiltration, in places .1 mm. in width. This zone extends over a considerable extent in the section, and its relation to the sebaceous-like epithelium is not apparent. The lining of squamous epithelium shows atrophy in places; in other places slight hyperplastic changes, consisting of a loss of the characteristic basal layer of cells

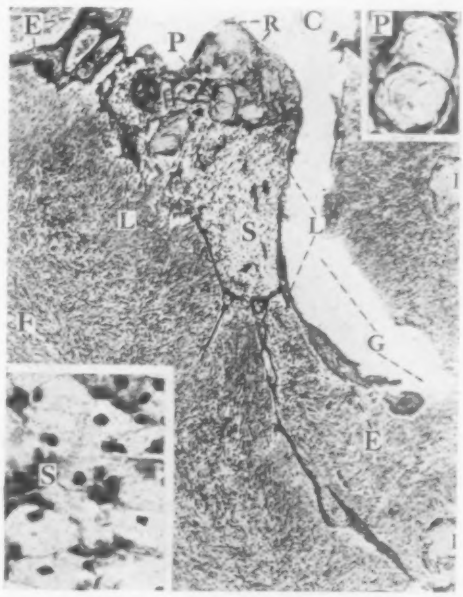


FIG. 18.—Case III. Enlargement of boxed area of Fig. 17. Note the appearance of the epithelium at *S* which under still further enlargement in the left lower corner is seen (*S*) to be made up of cells resembling epithelium. This mass of degenerated or metaplastic epithelium (*S*) is surrounded by a thin layer of modified squamous epithelium (*L*) directly continuous with the epithelial lining (*E*) of the cyst. (*cf.* preceding figure.) Part of this mass bordering the cyst is composed of keratinized epithelium (*R*) with pearl formation (*P*) (enlarged in the right upper insert). Other groups of keratinized cells at *I*. At *G* the section is broken. Cavity of cyst at *C*.

and irregularity in size and shape of the epithelium. In the same section isolated islands of stratified epithelium are found lying 1 mm. deep in the fibrous wall, but it seems probable that such islands are due to transection of down-extending processes.

In sections from a mass of tissue at the base of the cyst, scattered through a fairly loosely meshed stroma very rich in lymphocytes (Fig. 19, *R*) and plasma cells are a number of lipoid epithelial cells (Fig. 19, *S*) undergoing further degenerative changes. Often where several lie together the cell borders are obscure. In many cases the delicate cytoplasmic reticulum has largely disappeared, leaving a large, nearly clear cell, with a very faintly staining cytoplasm, from which the nucleus often has disappeared. In a few cases a globular clear space presents apparent evidence of a fatty transformation. In the same locality a number of foreign-body giant-cells have arranged themselves around shaft-like clear spaces (Fig. 19, *C*) in the tissue. It seems obvious that transformation of material from the lipoid cells into cholesterin crystals has taken place, and that the latter are responsible for the foreign-body giant-cell reaction. Near by (Fig. 19, *D*) there is a large cystic area filled with amorphous pink-staining detritus, through which a few crystalloid clear spaces are scattered. This material resembles histologically that of a sebaceous cyst, and the presence of so much degenerating lipoid epithelium in the wall points pretty clearly to its origin. As to the origin of this lipoid epithelium, it is difficult to determine definitely whether it it is the result of metaplastic or degenerative changes. The epithelial nature seems indicated by the presence of such areas (Fig. 17, *S*) entirely within the squamous epithelial lining of the cyst. In favor of a degenerative process are the absence of typical arrangement as sebaceous epithelial glands, association of other degenerative changes, and the fact that such lipoid degenerative changes are not uncommonly found elsewhere, particularly in association with chronic inflammatory conditions.

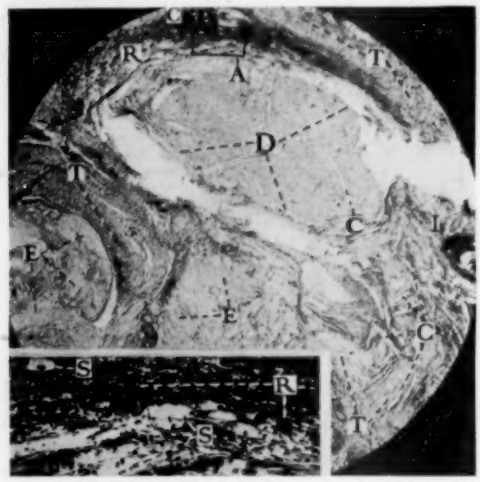


FIG. 19. — Case III. Low-power photomicrograph through tissue at base of cyst. Keratinized stratified epithelial masses at *E*. The fibrous stroma (*T*) shows round-cell infiltration (*R*) in some places, in others the occurrence of numerous crystals (*C*). The latter occur also in the debris (*D*) filling the cyst-like space. The insert below is an enlargement of the squared area (*A*) at the edge of the mass of amorphous debris (*D*). In the insert numbers of degenerating sebaceous epithelial cells (*S*) (*cf.* Fig. 18, *S*) are seen. It seems likely that the area (*D*) is composed of the broken-down material of these cells. The presence of cholesterin crystals supports this possibility.

In sections of all the blocks taken from the larger masses of tissue present at the base of the cyst the structure is more complex. Here (at the base of the cyst) hyperplastic and degenerative processes involving both epithelium and stroma had resulted in the production of masses or excrescences the size of a pea or larger, which projected into the cavity of the cyst. Macroscopically these were seen to contain calcified material, and in the *protocol* macroscopically they were attributed to the presence of cholesterin

crystals. Microscopically these masses are seen to be composed largely of areas of necrotic keratinized or hyalinized epithelium (Fig. 20), much of which has undergone calcification (Figs. 23 and 26, *C*). Under the low power one sees the fibrous wall of the tumor lined by irregular squamous epithelium. The necrotic epithelium is contiguous to the latter, and tends to become more prominent as the cavity of the cyst is approached. The tissue bordering the cyst cavity is ragged in outline and composed almost entirely of necrotic masses, which show evidences of desquamation into the cyst cavity (Fig. 20, *C*). One mass, 3 x 2 mm. in size, composed entirely of keratinized and hyalinized necrotic epithelium, was noted in the gross as a bit of chalky material. As to the nature of the necrotic change, there is little doubt that keratinization plays a large part. In a number of epithelial processes, or "pearls," in which the outer layers are not completely necrotic, keratohyalin granules are present in abundance (Fig. 22, *L*). These stain intensely with hæmatoxylin in the usual preparations, and it was not found necessary to employ Heidenhain's method or the Gram-Weigert stain for their demonstration. They appear as discrete fine or coarse, deep blue granules, scattered through the cytoplasm. In such cells as they occur the nucleus has lost its staining affinity to a varying degree, some completely. Occasionally these granules are seen in completely keratinized cells in the centre of a nest of dead epithelium, but usually, and much more abundantly, they occur at the periphery of such masses (Fig. 22, *E*), often in half-moon or sickle-shaped cells (Fig. 22, *G*).

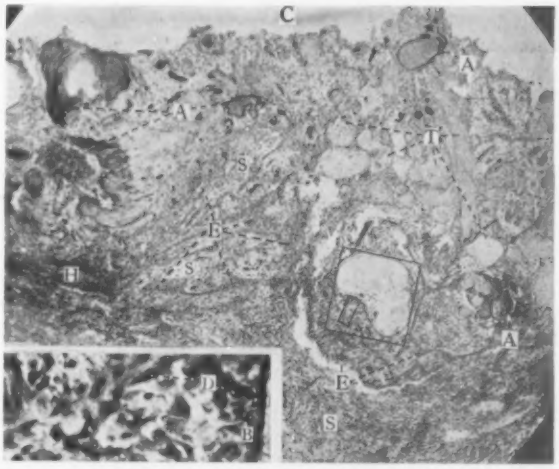


FIG. 20.—Case III. Low-power photomicrograph through one of the masses at the base of the cyst. Necrotic keratinized masses (*T*) may be seen, some of which (*A*) are partly calcified. The stroma (*S*) becomes scanty toward the cyst cavity (*C*) into which the necrotic tissue is desquamating. Hyperplastic atypical squamous epithelium (*E*) has invaded the stroma (*S*). The small squared area is enlarged in the insert. At *B* is seen the atypical basal layer. Irregularly formed epithelial cells are seen with heavily chromatinized cells at *D*. *H* is an area of recent hemorrhage.

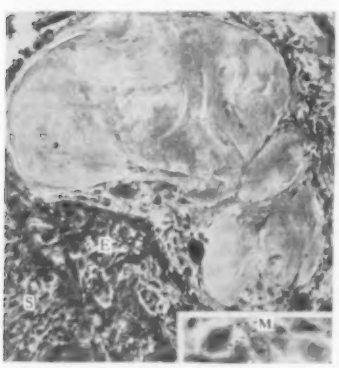


FIG. 21.—Case III. A higher power of the larger squared area of the preceding figure. The refractile completely hyalinized area shows scarcely any evidence of its epithelial origin. It is a further degenerative stage than the keratinized masses in which the outlines of the dead epithelial cells may still be seen (*cf. E*, Fig. 27). Note the atypical squamous epithelial hyperplasia (*E*) with a mitotic figure (*M*) in the insert (enlarged from a similar area). There is a moderate degree of round-cell infiltration of the stroma (*S*).

At the base of the cyst the epithelial lining itself is frequently composed of keratinized stratified epithelium, viable squamous epithelium being scanty and fragmentary. A fragment of viable, modified, squamous epithelium from the base of the cyst is shown in Fig. 24, at "T" pro-

jecting into the cyst cavity. This area is interesting histologically, as it shows well-defined *adamantinoma* characters. At the periphery (Fig. 24, *G*) is a layer of deeply staining cylindrical cells (Fig. 24, *L*), placed at right angles to the underlying cells. The cells of the peripheral layer where well differentiated show a distal cytoplasmic zone, with long, oval, dark-staining nucleus occupying the proximal two-thirds of the cell. The nuclei of the underlying cells are often larger and more vesicular, the cells themselves lying at right angles to the columnar layer, and have a well-marked spindle-cell appearance (Fig. 24, *S*), with definite intercellular bridges. These cells also show an occasional arrangement into concentric whorls, with flattened peripheral layers, but no keratinization. The same zone shows several small cysts (Fig. 24, *C*) lined by cubical or columnar epithelium. One of the smaller of these cysts contains a calcified lamellated concretion (Fig. 24, *I*). That such concretions may

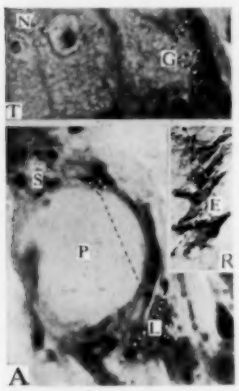


FIG. 22.—Case III. In *A* at *P* is a necrotic keratinized epithelial "pearl" in which the cell outlines are indistinguishable. This area is surrounded by concentric layers of cells which contain larger (*L*) and smaller (*S*) keratohyalin granules. In the insert (*R*) at the right may be seen more densely staining granules (*E*). In the insert (*T*) above, under oil immersion magnification discrete sharply outlined keratohyalin granules (*G*) are present in a sickle-shaped cell which partly encircles the periphery of a keratinized cell. The necrotic nuclei of two keratinized cells at *N*.

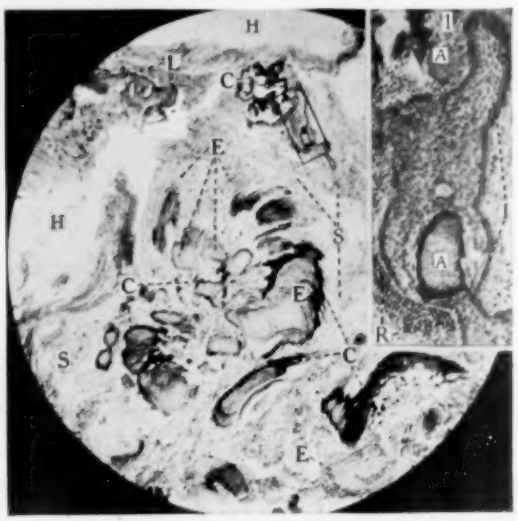


FIG. 23.—Case III. Lower-power photomicrograph showing masses of keratinized (necrosed) epithelium (*E*), calcified (*C*) to a varying extent, scattered through the sparse stroma (*S*). The squared area at a higher magnification, in the insert, shows the characteristic cylindrical cell peripheral layer (*I*) of the adamantinoma epithelium. Keratinized partly calcified epithelial groups at *A*. Note the round cell infiltration of the stroma at *R*. At *L* is seen a second bit of viable epithelium bordering the cavity (*H*) of the cyst.

be a secretory rather than a degenerative product seems probable, since the presence of small amounts of mucoid débris appears to be an evidence of the secretory nature of the columnar epithelial cells. In the third or central zone reticulation is a very striking feature and tends to increase as the centre is approached. The nuclei of the reticulated cells are shrunken and atrophic, frequently having disappeared entirely. The cytoplasm is reduced to wisp-like strands, often in its radiate arrangement resulting in the appearance of the so-called *stellate* cells (Fig. 24, *Y*). Occasionally both cytoplasm and nuclei of several cells have disappeared, leaving a clear space (Fig. 24, *O*). This reticulation is usually interpreted as a hydropic phenomenon. Its appearance is somewhat similar to that of a markedly œdematous tissue. The small clear spaces do not have the rounded contour of fat globules. Elsewhere viable squamous epithelium, which lines the cyst cavity, shows such reticular changes in varying degrees.

In places hyperplastic changes have occurred in the epithelium which surrounds the keratinized stratified masses. Such epithelium lies in the stroma as strands (Fig. 20, *E*) or irregular collections of atypical squamous epithelial cells (Fig. 21, *E*), or separates the masses of dead epithelium from the underlying fibrous zone. The individual cells are much larger and tend to stain more pinkly. The nuclei are likewise large and very vesicular (Fig. 21, insert), taking the stain lightly. A number of hyperchromatinized cells are found and a few atypical mitoses (Fig. 21, *M*). These atypical cells are continuous, with characteristic modified squamous epithelium, and also show occasional intercellular bridges. Frequently single or small numbers of such cells have undergone keratinization. These cells are of many shapes; large round or polygonal cells are present, but a tendency to an irregular spindle shape is more frequent. It is interesting that these hyperplastic epithelial cells occur only between the fibrous zone of the wall and the edge of the cyst cavity. Nowhere do they compose the invasive processes which have penetrated the fibrous zone of the wall. Despite this, one must attribute to them a local malignant nature on account of their cytological features and invasion of the stroma. The cells individually resemble cells of spindle-cell carcinoma rather than the less malignant basal-cell type.

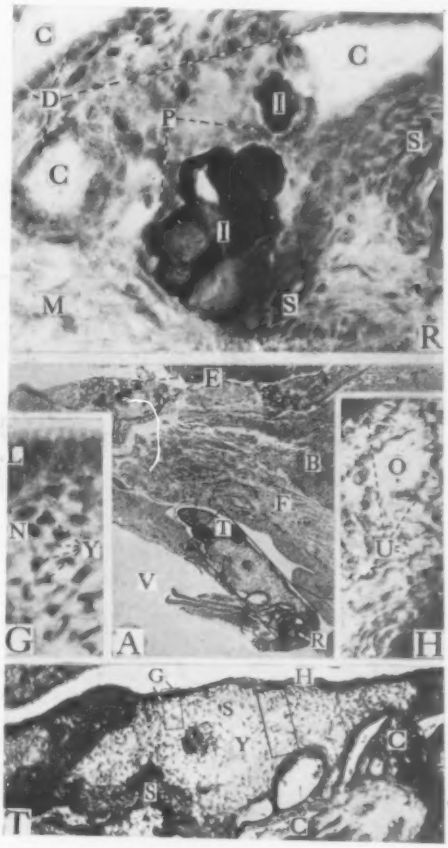


FIG. 24.—Case III. The central area (*A*) is a low-power photomicrograph of tissue from the base of the cyst. The enclosed area (*T*), enlarged slightly in the insert below, shows typical adamantinoma characters. The enlarged squared area (*G*), left central insert, shows the typical palisaded peripheral layer of columnar epithelium (*L*). At *S* and *N* one sees the spindle-shaped epithelial cells of the subperipheral, and at *V* the reticulated star-shaped cells of the central zone. The process of reticulation with atrophy of the cells leads to an occasional hiatus (*O*, insert *H*), surrounded by shrunken nuclei (*U*). The presence of cystic spaces (*C*) is better shown in the insert above: an enlargement of the small boxed area (*R*). The cystic spaces (*C*) are lined with cuboidal epithelium (*D*). At *I* are calcified masses filling spaces in which a trace of an original epithelial lining (*P*) may be seen. These masses (*I*) are probably a calcified secretory product. At *E* are other traces of reticulated epithelial lining in which calcific concretions may be seen. At *F* the fibrous wall. *B*=area of hemorrhage, *V*=central cavity of the large cyst.

Keratinization has involved groups of cells varying from a few cells concentrically arranged, resembling epithelial pearls (Fig. 18, *P*), to large stratified masses Fig. 23, *E*), which may be so numerous as to fill the lower-power field of the microscope. These large areas may be completely deprived of blood supply, and isolated small vessels plugged with calcific concretions are found occasionally in the surrounding stroma The cell and nuclear outlines (Fig. 25, *R*, *E* and *n*) may usually be recognized, the nucleus appearing as a round, almost color-

less, space in the pink cytoplasm. Occasionally, however, the cell outlines have largely disappeared, the cell bodies having fused into a homogeneous, shining, hyalinized mass, in which traces of the original cell outlines may be seen very indistinctly (Fig. 21). The degenerative changes in the epithelial masses apparently have no definite relation to the vascularity of the adjacent stroma.

Calcification has involved the dead epithelium to an extent varying from a light *dusting* of amorphous blue staining material, often involving only the exterior of a necrotic mass (Fig. 20, *A*), to a diffuse, deep blue staining of an entire group of cells (Fig. 29, *I*). Sometimes the calcium salts are present in granular form, but such granules are not as regular in outline, discrete, or densely staining as the keratohyalin granules.

Foreign-body giant-cell reaction is an interesting phenomenon in its relation to the keratinized and calcified epithelium. This foreign-body reaction seems somewhat greater where the stroma is young and vascular in appearance. These giant-cells are formed in the stroma possibly owing to the presence of calcium salts. It appears that they are engaged in dissolving out the calcium salts and in phagocytozing the necrotic epithelium. Evidence of this is seen in a number of places. Instances are noted where the stratified masses of dead epithelium have retained the calcium salts save where foreign-body giant-cells lie closely applied to the periphery (Fig. 25, *G*). Regarding the phagocytic action, it is sufficient to note that in a number of instances fragments of dead epithelium are seen partially encircled (*cf.* Fig. 12, *G*) or engulfed by foreign-body giant-cells. Other instances are observed of isolated small nests of dead epithelium which are rimmed, invaded, and partially absorbed by these giant-cells.

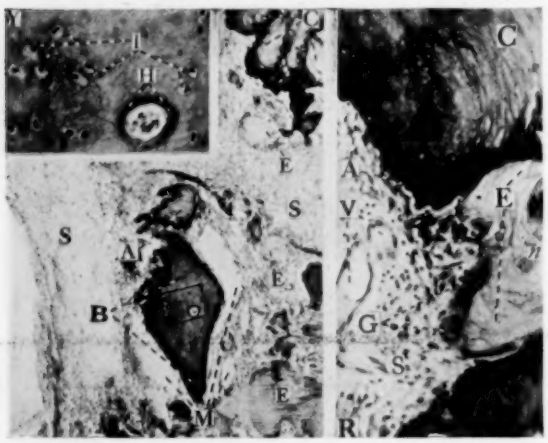


FIG. 25.—Case III. A low-power photomicrograph showing the presence of an island of osseous tissue at *B*, closely associated with adjacent areas of dead epithelium (*A*). The squared area is enlarged above in the insert (*V*) where an Haversian canal (*H*) is plainly shown; near by are a number of bone cells (*I*). Below at *M* are vascular spaces. A cluster of partly calcified keratinized stratified epithelial masses at *C*. Non-calcified similar epithelium at *E*. Stroma=*S*. In the insert (*R*) at the right two foreign-body giant cells (*G*) are seen closely attached to a mass of keratinized stratified epithelial cells (*E*). The outlines and some of the nuclear shadows (*n*) of these necrotic cells are shown. At *C* is a similar mass but calcified at its periphery (*A*). Blood-vessels =*V*. Stroma=*S*.

True bone, with Haversian canals (Fig. 25, *B*, *H*) and viable bone corpuscles (Fig. 25, *I*), is present in the tumor. The osseous processes stain a deep lavender to blue color, and often have a peripheral zone of pink-colored bony matrix (osteoid tissue), which contains immature bone corpuscles. All areas in which bone formation is taking place seem to be associated with surrounding or adjacent zones of vascular stroma (Fig. 25, *V*, *S*), which often are somewhat myxomatous in appearance, and show a scattering of lymphocytes and plasma cells. At the periphery of calcified epithelial masses foreign-body giant cells (acting as phagocytes) are often present (Fig. 29, *G*), and where bone is being laid down osteoblasts are to be seen

(Fig. 28, *O*). Thus a process is present which finds its analogy in normal ossification of the long bones, *viz.*, there is a substitution of osseous tissue for the calcified tissue, and never a direct conversion of the pre-existing tissue (calcified epithelium, or in the case of the long bones, calcified cartilage matrix or degenerating cartilage cells) into bone.

The processes of ossification is taking place at the periphery of keratinized epithelial processes (Figs. 26 and 27). In the interior areas of such processes as are almost completely ossified at the periphery (Fig. 27) substitution of bone for dead epithelium proceeds without the intermediation of extraneous phagocytes (foreign-body giant-cells) or of stroma (Fig. 27, *N*), the growing bone cells apparently possessing the property of absorption of dead epithelium and calcium salts and of proliferating. Here the advancing line of ossification is irregular, single, newly formed bone cells lying somewhat in advance of their fellows (Fig. 27, *N*). Such newly formed bone cells have the calcium content (as denoted by their dark staining) of adult bone cells, apparently having directly appropriated the calcium content of the necrotic epithelium. The newly formed bone tissue follows closely the lines of stratification (often curvilinear) of the dead tissues which is being replaced. Not always is the internal limit of osseous advance irregular; sometimes it is sharply delimited (Fig. 28, *D*, *E*).

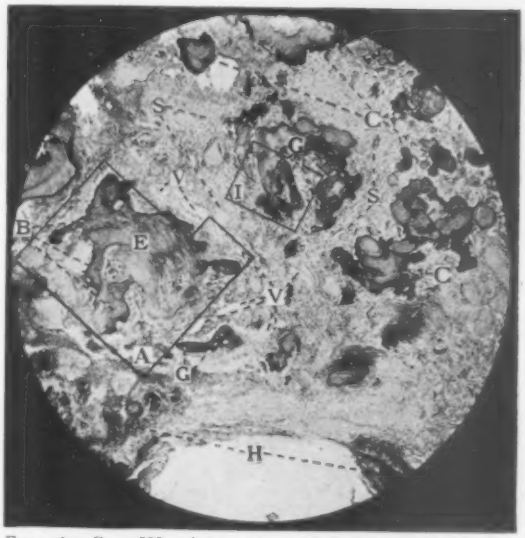


FIG. 26.—Case III. A low-power photomicrograph showing the close relation between the masses of keratinized (necrosed) epithelium and the newly formed bone tissue. At *E* is a mass of keratinized epithelium which is being replaced by bone tissue growing in from the periphery. An enlargement of this squared area (*A*) is shown in the next figure. Smaller masses of dead (keratinized) epithelium are shown at *C*, all of which are partly calcified, the calcium slats in most instances being deposited at the periphery. Other areas of bone formation are shown at *G*. These islands of tissue lie strewn through a young fibrous stroma (*S*) which is unusually vascular (*V*) near the areas of bone formation. The squared area (*I*) is enlarged in a subsequent figure. Hemorrhagic areas at *H*.

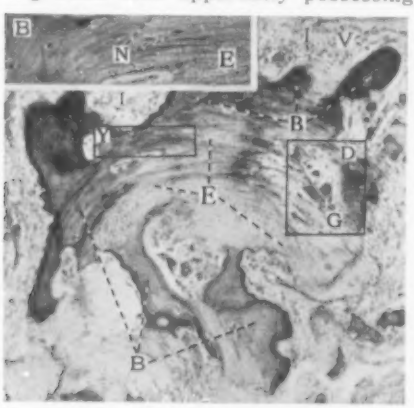


FIG. 27.—Case III. An enlargement of the squared area (*A*) of Fig. 26. The layers of stratified dead epithelium (*E*) are more clearly visible. This is almost surrounded by bone (*B*) which is growing into and replacing the dead tissue: a *substitutive* and not a "*metaplastic*" process. The small squared area (*V*) is shown in the insert above further enlarged. Here one sees the nuclei (*N*) of bone cells which are extending into the keratinized epithelium (*E*). At *I* is the most peripheral zone of uncalcified newly formed bone. *V* = blood-vessels. The larges squared area containing an island of bone (*D*) and two prominent giant cells (*G*) is further enlarged in Fig. 28.

Hypophysis.— The hypophyseal sections are grossly of normal size, although somewhat flattened. The sections contain both anterior and posterior lobes. There seems to be

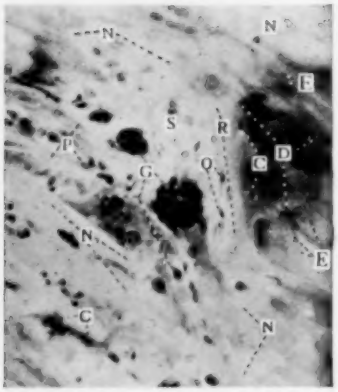


FIG. 28.—Case III. A further enlargement of the area (*D*, *G*) squared in Fig. 27. At *G* are foreign body giant-cells which are phagocytozing hyalinized strands (*N*) of dead epithelium. At the right is an area of newly formed bone (*D*). *R* is the zone of newly formed bone matrix, incompletely calcified, closely applied to the periphery of which are two osteoblasts (*O*). Two of the latter have been enclosed in the bone and become mature bone corpuscles (*C*). Also growth of bone is shown into the dead epithelium, the outlines of several adjacent keratinized cells with faintly visible nuclear spaces being apparent at *E*. Stroma=*S*.

possibly a slight increase in eosinophilic elements throughout the anterior lobe. Chromophobe and basophile cells are relatively very few in number. There is a small (150μ) area found in which the neutrophile elements are hyperplastic and the stroma decreased in amount; the area is circumscribed, but not encapsulated, resembling somewhat a miliary adenoma. The pars intermedia shows only a few rather small tubules filled with colloid; no large colloid cysts are present.

Thyroid.—The picture is essentially a normal one. Practically all of the vesicles are filled with colloid. There is no tendency to hyperplasia.

Adrenal.—Shows nothing abnormal save perhaps a slightly increased vacuolization of the cells of the zona fasciculata. Perhaps a slight diminution in size of the gland.

Ovaries.—Grossly were noted as small. In the microscopic preparations they seem slightly smaller than normal. No corpus luteum is found. Numerous cysts are present, from 2 to 4 millimetres in diameter. These are filled with a finely granular, pink-staining, homogeneous material, which represents the gelatinous material seen macroscopically in the formalin-fixed specimen. These cysts (Fig. 30, *O*) are lined by young connective-tissue elements, which show occasional mitoses, apparently a growth acceleration in an effort to fill in the cavities. Numerous primordial and a few developing follicles in the cortex, but no nearly mature follicles.

Salpinges.—Sections from one of the Fallopian tubes show a definite, rather early miliary tuberculosis (Fig. 30, *S*), which in the gross was at first unsuspected. The lumen on reëxamination of the gross specimen is seen to be occluded near the fimbria for a distance of 1 cm. by opaque-looking material. The other tube is patent throughout.

Uterus.—Macroscopically was slightly below normal size, measuring 5.5 cm. in length, and of normal relative thickness.

Microscopically the endometrium shows an atrophy (Fig. 30, *U*), which closely approaches that of the senile type. The sur-

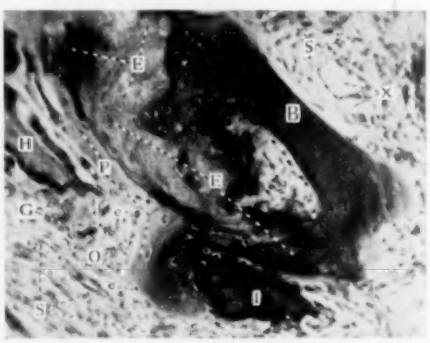


FIG. 29.—Case III. An enlargement of the squared area *I* of Fig. 26. The dead epithelium (*E*) is being replaced by bone. At *B* is a large mass of bone containing mature bone cells. Part of the periphery of *E* is invested by a layer of newly deposited bony matrix (*P*) which is in turn approximated by a number of osteoblasts (*O*). Two of the latter at *e* are seen entering the osseous matrix (*P*) to take up the rôle of bone cells. Note the greater activity of the stroma cells (*S*) in the left lower corner than above near *X* (vascular spaces) where bone formation has ceased. Giant cell formation at *G* near a spine of dead epithelium (*H*) with calcified periphery. At *I* a mass of solidly calcified epithelium.

face epithelium has retrogressed to a flatter type or is desquamated entirely in places. The endometrium is greatly diminished in thickness, and the uterine glands very few in number, small and atrophic in appearance. The interglandular tissue is greatly increased in amount, and near the surface in places is of a definite fibrous character. The atrophy of the glandular tissue is present also in the cervical region to an equal extent.

Pancreas.—Certainly no increase in number or size of the islands. No fibrosis.

Kidney.—Normal.

No other tissues available (partial autopsy).

Summary of Case III.—In a young married woman, twenty years old, the first symptom of intracranial tumor was the establishment of persistent amenorrhœa at seventeen years of age. A year later there was a transient attack of hemianopsia associated with severe headache; this was not followed by other severer attacks until over a year afterwards, when failing vision and general pressure symptoms supervened. The

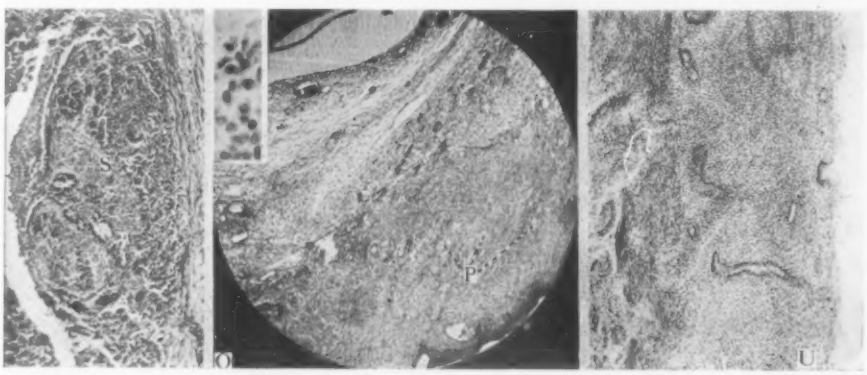


FIG. 30.—Case III. At *S* a conglomerate tubercle without caseation from the unilateral early tuberculous salpingitis. At *O* a photomicrograph of the ovarian cortex showing (above) the edge of one of the large cysts and below (*P*) numerous primordial follicles. The small upper insert shows a mitosis from the wall of one of the cysts, which, however, are not malignant. At the right is shown the endometrium (*U*) which presents practically a senile picture. The individual was twenty years old but had had amenorrhœa for four years.

röntgenogram showed a calcified area just above the sella, and the *fundi* showed a marked post-neuritic atrophy. Following evacuation of the suprasellar cyst by means of a lateral craniotomy there was relief of pressure symptoms for three months, followed by a gradual return of the old *status*. After the second operation (partial extirpation of lining of cyst) the patient succumbed.

The autopsy studies demonstrate the presence of a partly calcified suprasellar cyst, apparently developed from a squamous epithelial inclusion of the hypophyseal duct, which had compressed the third ventricle above and was separated from it only by a thin membrane (Figs. 15 and 16). Histologically, the cyst showed a squamous epithelial lining with the so-called adamantinoma structure, associated with small areas of localized malignant epithelial hyperplasia, and other areas of interesting calcification of masses of dead keratinized epithelium which showed par-

tial replacement by osseous tissue growing into the dead epithelium from the stroma. Involved in the process of absorption and replacement of the keratinized and calcified epithelium was a marked foreign-body giant-cell reaction (see photomicrographs) and other cellular changes apparently analogous with the normal skeletal process of ossification. The ovaries of this twenty-year-old girl showed a cessation of ovulation with absence of corpora lutei. The endometrium showed histologically a marked atrophy resembling the senile type. The hypophysis, thyroid, adrenals, and pancreas showed no apparently important histological alteration. The anatomical diagnosis of this case may be rewritten as follows: Suprasellar calcifying cystic squamous epithelial tumor of infundibulum (developed from an inclusion of the hypophyseal duct), with adamantinoma characters, localized malignant epithelial hyperplasia, degenerative and osseous regenerative changes; compression of aqueduct of Sylvius; internal hydrocephalus (slight); atrophy of endometrium; adiposity (slight). Operations: (1) Lateral craniotomy, evacuation of cyst; (2) partial extirpation of lining of cyst wall; cerebral œdema. Subsidiary: Early unilateral tuberculous salpingitis (primary (?)—incomplete autopsy).

A histological study is presented in the next case of a true Rathke pouch cyst, which is strikingly different from, although sometimes confused with, hypophyseal duct cystic tumors such as those presented above.

CASE IV.—*Ciliated columnar epithelial-lined cyst developing from an inclusion of Rathke's pouch, associated with a huge adenoma, in an elderly negro man. Intracranial and subsellar extension of tumor with displacement of Rathke cyst into sphenoidal cavity. Primary optic atrophy. Operation. Death. Autopsy.*

Abstract of J. H. H. Surgical History No. 40428½, a negro male laborer fifty years old, was transferred August 14, 1916, to the Surgical Service of the Johns Hopkins Hospital from the medical service, to which he had been previously admitted complaining of "blindness."

The history is negative save for an injury (struck by a rock) to the left eye at the age of twenty-five, following which dimness of vision of the left eye resulted permanently. He continued to work as a day laborer handicapped by the practical loss of one eye until November, 1915, when failing vision in the other eye compelled him to stop work.

Apparently there had been no vomiting, headache, ataxia or convulsive episodes.

Examination.—A well-nourished, well-developed elderly negro of short stature. General examination quite negative except for complete blindness due to double optic atrophy (ophthalmoscopic), immobile pupils, and moderate impairment of hearing in both ears. Röntgenographic report (Dr. F. H. Baetjer): Destruction of sella, suggesting tumor. Wassermann: Negative. Urine: Negative.

Operation (August 15, 1916, Doctor W. E. Dandy).—Through the left lateral approach a tumor in the hypophyseal region about the size of an orange was removed which weighed 77 grams. The tumor

was firmer than most adenomas, and save for its attachment at the sella shelled out much like a dural endothelioma.

The patient died about nine hours after the operation.

For the pathological material I am indebted to Dr. Montrose T. Burrows who made the autopsy.

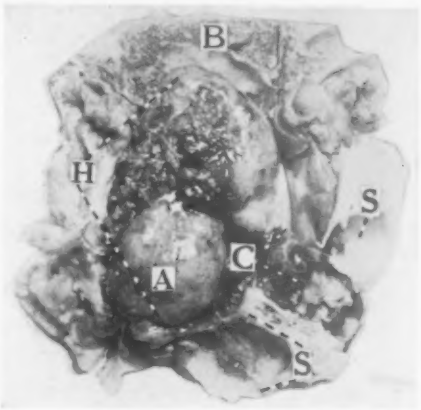


FIG. 31.—Case IV. Shows the under surface (*H*) of the portion of the adenomatous tumor of case IV which has expanded the sella and broken into the sphenoid. The sphenoid walls (*S*) and the basilar process (*B*) have been reflected and the distended pear-shaped cyst (*C*) attached to the capsule of the adenoma is shown. The histology of this cyst is shown in Figs. 32 and 33.

Autopsy (No. 4787).—*Anatomical Diagnosis.* Adenoma of anterior lobe of hypophysis. Destruction of sella turcica. Infiltration of basilar process of occipital bone. Operation: Enucleation of extension of tumor under frontal lobe. Bronchopneumonia. Encapsulated apical tuberculosis (bilateral); fibrous pleurisy, pericarditis, and perisplenitis.

Body.—Height 5 ft. 5 2/5 in. (163 cm.). A well-nourished dark mulatto. Musculature well developed. Genitalia of normal size; testes of normal consistency.

Head.—The skin flap on the left side measures 15 x 10 cm. in diameter; the opening in the skull measures 12 x 8.5 cm.

After injection *in situ* with 10 per cent. formalin the brain was removed, and the sella, together with adjacent parts of the base of the skull, removed *en masse*.

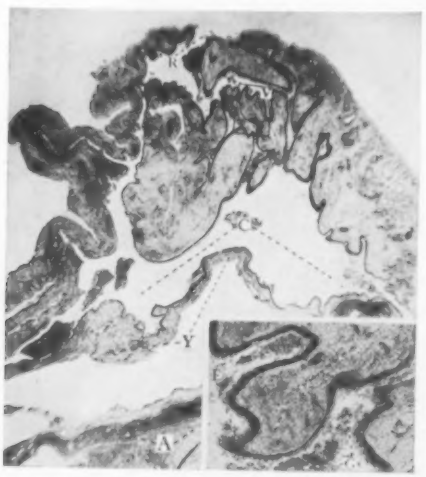


FIG. 32.—Case IV. Low power (10 diams.) photomicrograph of collapsed wall of cyst shown in Fig. 31. The wall is ruptured at *R*. The proximal wall (*V*) of the cyst has been stripped away from the capsule covering the adenoma (*A*). *C* = cavity of collapsed cyst. The convoluted character of the cyst wall is shown above. The squared area (*V*) is shown enlarged in the insert at the lower right. *F* = connective-tissue stroma of one of the convoluted projections. *E* = tall ciliated columnar epithelial lining. *G* = desquamated epithelial cells.

Doctor Burrows kindly gave me the autopsy material for further study. His thorough autopsy is only partly abstracted above. (The lesions of the other organs—see anatomical diagnosis—being irrelative.) A study of the large hypophyseal adenoma may be included in a subsequent publication.

Description of Cyst.—The sella (Fig. 31) is filled with solid tumor, the cut surface of which at the top is level with what is left of the eroded clinoids. The sella measured 2.5 cm. antero-posteriorly, 2.4 transversely, and 1.7 cm. vertically.

On dissecting away the bone fragments adherent to the under surface of the intrasellar portion of tumor, the sphenoidal cavities were seen to be filled by solid growth and two small cysts, the larger of which (Fig. 31, *C*) measured 1.5 cm.

in diameter, and was attached by a narrow pedicle to the capsule of the solid growth. On puncture of the larger cyst a few drops of fluid escaped. There was no cystic change in the solid tumor in the vicinity of the pedicle of the cyst.

Microscopic Examination.—The cyst wall is composed of fibrous tissue, with occasional myxomatous and hyaline areas. Extending into the cyst cavity are numerous thick convoluted, papillary infoldings of fibrous tissue (Fig. 32). Both wall proper and papillary projections are lined with a single layer of very tall, ciliated, columnar epithelium (Fig. 33, *E*), which shows occasional goblet cells (mucous secretory). In the wall of the cyst one sees groups of numerous gland-like structures, such as often are seen in the region of the cleft between the anterior and posterior lobes. Some of these glands contain a colloid-like material. A few groups of cells are seen composed of large polygonal cells, which are larger in the centre of the group. Here one sees occasional intercellular bridges. The wall of the cyst is directly continuous with the capsule of the solid tumor at either extremity of the section. Throughout the wall there is a scattering of polymorphonuclears, plasma, and mast cells. Large numbers of desquamated, ciliated, columnar, epithelial cells (Fig. 32, *G*) lie in places in the cavity of the cyst.

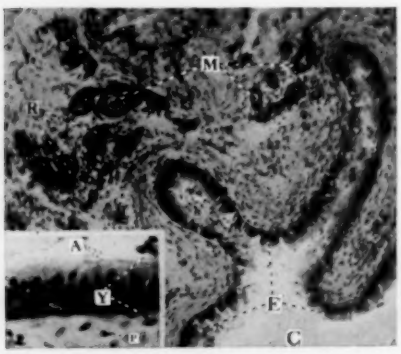


FIG. 33.—Case IV. A somewhat higher magnification showing groups of glands (*M*) in the wall of the cyst similar to ones which occur commonly in the pars intermedia in the vicinity of Rathke's cleft between the anterior and posterior lobes of the hypophysis. *R* = round cell infiltration. At *E* the columnar epithelial lining with ciliated periphery is seen. In the insert *Y* = the layer of palisaded cells, with ciliated zone at *A*. *P* = leucocyte.

Summary of Case IV.—This case is presented so briefly above that a summary is hardly necessary. The case is included solely on account of the presence of the small cyst which is an example of those which it is desired to show are distinctly different from the squamous-cell cysts detailed above. Lined with a single layer of ciliated columnar epithelium the wall contained a number of gland-like colloid-containing structures easily recognizable as constituents of pars intermedia. These furnish additional proof of the origin of the cyst from the vicinity of Rathke's cleft, probably either from the cleft itself or from a persistent embryonic diverticulum thereof. The location of the cyst in the sphenoid cavity is readily explained by pressure of the superimposed enormous hypophyseal adenoma, weighing nearly 100 grams, which had destroyed the floor of the sella.

DISCUSSION

Etiology.—Although the inciting factor or factors in the etiology of hypophyseal duct tumors remains obscure, some light has been thrown on the probable circumstances of origin. The demonstration of Erdheim of persistent fetal inclusions of squamous epithelium in the precise position of origin of these tumors in a large percentage of normal hypophyses points clearly to the significance of the embryonal (Cohnheim) theory in

these tumors. The early age at which a number of these tumors have become large enough to cause symptoms is also a fact favoring the congenital nature of the tumor anlage. One case has been reported (Erdheim, 1906) in which the individual succumbed when only five years old, and a large malignant squamous epithelial tumor ("hypophysengang carcinom") was found. Among other cases occurring in later infancy or early youth are those of: Zenker (1857), aged nine years; Walker (1902), nine and one-half years; Erdheim's (1904) Case III, eleven years; Case II of the writer, eleven years. Three other cases of Erdheim (1904) were sixteen, twenty, and twenty-one years old, respectively, in which adolescent group belong the Case III of the writer, the case reported by Jackson and Kanavel, and a number of others. Jackson (1916), from a study of 38 cases in the literature, stated that 33 per cent. occur under twenty years of age, 42 per cent. between twenty and forty years, and 25 per cent. over forty years. As to sex the cases were about equally divided. Trauma has been only rarely associated as a possible factor.

CASES COLLECTED FROM THE LITERATURE

Jackson (1916) reported an hypophyseal duct tumor and assembled thirty-seven others from the literature. To these thirty-eight should be added the following seventeen cases, many of which were apparently overlooked by Jackson. Possibly there are a number of other reports I have been unable to find, particularly in Teutonic periodicals of the war period, which are not yet fully available. Also there are a number of disputable cases, such as that of Ehlers (1910), which I will not list. The older cases collected by Erdheim of Boyce and Beadles, not confirmed histologically, are not included. However, a number of undoubted additional reported tumors belong in this group, and of these I have found the following: (1) Gotzi and Erdheim (1905) in a chiefly clinical study reported the pathology of a tumor apparently similar to that reported by Saxer (1902). (2) Erdheim (1906) reported an additional tumor, a solid and cystic, "*hypophysengang-geschwulste*," in a five-year-old child. (3) Fahr (1918). (4) Schwab (1913). (5) Guiseppe Masera (1910), and (6) Mensinga (1897), reported very malignant spinal-cell carcinomas of this group, in which has been placed also the case of (7) Rothmann (1893). (8) Case II of Strada (1911), "a benign, multilocular, cystic, papillary, squamous, epithelial tumor of the hypophyseal duct," previously reported by Buhecker in a Strassburg (1893) dissertation simply as, "a cystic tumor of the hypophysis," is not contained in Jackson's table under either Buhecker's or Strada's name, and should be included. (9) The "papillary tumor of the hypophysis" of Gut (1899) apparently was overlooked by both Erdheim and Jackson. (10) The case of Makay and Bruce (1909), of "epithelioma of the hypophyseal duct" belongs and is apparently the best example of the resemblance which these tumors may have for the basal-cell epithelioma of skin. (11) Farnell (1911) recorded a typical tumor. (12) Teutschlaender (1914) described a "cystic, carcinomatous, hypophyseal-duct adamantinoma." (13) Harms in the same year added one, and (14) Warthin in 1916 described an adamantinomatous tumor. These, with the three examples (Cases I, II and III) of the writer, when compiled with the thirty-eight cases tabulated by Jackson in 1916, bring the total number of cases assembled from the literature to fifty-five.

Nomenclature.—The differentiation of the squamous equithelial tumors of hypophyseal duct origin from the majority of "cholesteatomas" and "dermoids" of the subdural space was indicated by Erdheim (1904) and has been emphasized more recently by Teutschlaender (1914; p. 243). It is believed that the squamous cell rests from which most dermoids and cholesteatomas arise are carried into the cranium coincidently with the closure of the cerebral vesicles. It was pointed out that basal cholesteatomas rarely lie in the midline and are often situated below the tentorium, whereas hypophyseal duct tumors are found just behind (or below) the optic chiasm, or fill the sella, and a connection with the infundibulum or hypophysis is always demonstrable when the growth is small or of moderate size.

In the smaller field of tumors whose location pointed to an origin either from the hypophysis, infundibulum or from the third ventricle or its choroid plexus there are a number of squamous epithelial tumors in the literature attributed to ependymal or choroid plexus origin. There is the "Ependymal Papilloma" of Selke (1892); the Papilloma of the choroid plexus" of Fahr (1903); the "Epithelioma of the plexus chorioideus" of Ziegler (1902); and the "Epithelial (carcinomatous ?) tumor of the infundibulum and the third ventricle" of Saxer (1902). In most of these cases the tumor had closely involved or broken into the ventricle. Ingermann (1889) described a tumor arising in the sella containing cysts, epithelial pearls, intercellular bridges, and calcified material, and diagnosed "Hypertrophy of the hypophysis with cystic degeneration of the stroma." Erdheim's Case VII appears to have been first referred to by Rokitansky (1856) in his text-book and later (Erdheim, 1904, p. 674) correctly diagnosed as an hypophyseal duct tumor. Bregman and Steinhaus (1907) called their tumor a "Squamous cell epithelioma of the hypophysis." Höhl (1903) considered an origin from the pia mater: "Cystic pial-endothelioma."

Onanoff (1892) was the first to note the resemblance to adamantinomata of the jaw, and designated his tumor as an "Epithelioma of the anterior lobe of the hypophysis," stating that its structure was strong evidence of its ectodermal origin. Contrariwise, Walker (1902), finding calcified material with spongy bone in a tumor which apparently developed in the infundibulum, diagnosed a "Primary Osteoma of the Brain," and, concerning other osseous tumors of the brain described in the literature, decried "the looseness of description of the earlier writers" which "render their cases worthless when an attempt is made to collect examples of this form of growth."

From this veritable melting pot of terms have emerged a few which may be correctly and expressively used in naming the majority of squamous epithelial tumors of the hypophyseal region. *"Hypophyseal duct tumor"* (*"hypophysenganggeschwulste"*), the term originating with Erdheim (1904), is in good standing, as also is the designation of nearly

similar meaning "craniopharyngeal duct tumor." Bregman and Steinhaus (1907) suggested the term "squamous-cell epithelioma of the hypophysis," since "the hypophyseal duct exists for only about half the duration of fetal life." The term "adamantinoma," first applied by Onanoff (1892), indicates a tumor of the above origin with the specification of its particular histological differentiation into a structure resembling the neoplasms arising from rests of the *enamel organ* in the jaw. Since there is considerable variation in both the gross and microscopic appearance of these tumors, some of which are neither adamantinomas nor epitheliomas, the term "squamous epithelial hypophyseal duct tumor of the hypophysis and infundibulum" has suggested itself to the writer as especially applicable, indicating at once their fundamental histological and embryological derivation.

Clinical Diagnosis and Importance of Röntgenography.—The frequent association (70 per cent., according to Jackson) of the dystrophia adiposogenitalis syndrome together with the early appearance of primary optic atrophy, in contrast with the comparatively unusual or late occurrence of choked disk, has been emphasized (D. Lewis, 1910). At variance with the statement of Jackson (1916) that röntgenography is usually negative in hypophyseal duct tumors, the röntgenograms (Dr. F. H. Baetjer) were positive in all three of the above cases. In the röntgenogram of Case I, in which the tumor developed from a squamous-cell inclusion beneath the capsule of the anterior lobe, the sella was widely dilated and the clinoids eroded. This tumor was an intracystic squamous epithelial papillary tumor of relatively simple histology. In the röntgenograms of Cases II and III there were suprasellar calcified nodules, and in neither case was the sella enlarged. In both the tumor was suprasellar and each tumor presented adamantinoma characters with extensive necrosis of epithelium and subsequent calcific deposition. In two of Erdheim's cases in which röntgenograms were made suprasellar shadows caused by calcified material were found, but it does not appear that the diagnosis was made *intra vitam*. It seems that the finding of a shadow of a suprasellar calcified nodule in the X-ray plate of an individual with symptoms of intracranial tumor is highly suggestive of a calcifying squamous epithelial adamantinomatous tumor of hypophyseal duct inclusion origin. In scarcely any other condition in the vicinity of the sella turcica does such a localized nodular calcification occur. However, Dandy and Heuer (1916, Case V) referred to a single instance of such a shadow in a tumor, verified at operation, as developing from the optic nerve sheath. In another instance (Case VI) the same writers reported an interesting case of extensive dense calcification within the sella in an individual totally blind, but there was no opportunity for certification of the lesion.

As to the probable frequency of röntgenographic shadows due to calcification in squamous epithelial tumors of hypophyseal duct origin and basing an opinion on the frequency of the adamantinomatous type which is so prone to calcification and osseous changes, it would appear that

such shadows might be expected to be found in something like one-half of all squamous epithelial hypophyseal or suprasellar (infundibular) tumors, or, in other words, in the majority of tumors of the adamantinomatous type. The röntgenographic examination must be made by those specially trained. In a röntgenographic study of a hundred cases of brain tumors reported by Heuer and Dandy (1916) note is made of a certified tumor (Case III of the present paper) in which a similar shadow was present which by another observer had been considered normal; hence the röntgenologist should be familiar with the limits of normal variation in size and shape of the clinoid processes.

With regard to the question of differential röntgenographic diagnosis, another condition occurring in the vicinity of the sella may be briefly mentioned here which was also reported by Heuer and Dandy in the same monograph. The röntgenograms of a white man twenty-eight years old for four years a sufferer from intracranial pressure and ocular symptoms, showed extensive calcific concentric incompletely circular shadows indicating the periphery of a large mass above the sella. At autopsy a mass 24 cm. in diameter was found which was composed of two aneurisms, of the right and left internal carotid arteries, respectively. Heuer and Dandy in retrospect considered the ring-like shadows as rather characteristic of aneurism, as they found no similar calcification reported in the literature in any case of true tumor.

Histological Classification of Hypophyseal Duct Tumors.—Erdheim classified the tumors reported by him according to whether malignant or benign and whether the tumor had developed in the infundibulum or the hypophysis. It is doubtful that his alleged malignant tumors showed unmistakable metastases and he made no reference to the tumors with outspoken spinal-cell carcinoma characteristics, including obvious metastases.

The hypophyseal duct derived tumors may be conveniently placed in three groups arranged with regard chiefly to the microscopic morphology. The *first* is that of the simple papillary cyst, or intracystic papilloma with intracystic cauliflower papillomatous structure (Case I of the writer, cases of Selke (1891), Cornil and Ranvier (1881), Ziegler, and others). These intracystic papillary tumors are the simplest in structure and save when they have broken through the floor of the ventricle (pressure destruction) retain the simplest characters; the wall of the cyst usually shows no invasion.

The *second* group embraces the simpler and the more complicated adamantinomas, including the " autochthonous teratoids " of Ewing. Of the simpler adamantinomas the Case II of the writer is an example, while Case III is of more complex nature, simulating a teratoma, but not of true teratomatous nature. Similar cases are those of Hecht and several of Erdheim. Such tumors show local invasion or localized carcinomatous degeneration, but do not metastasize.

The *third* group consists of only five known cases, and so far as I

have determined none of them have been referred to in the American literature. The tumors of this group show all the ear-marks of malignant spinal-cell carcinoma and may extensively metastasize. In the fifth case more recently reported by Fahr (1918) the first symptoms were caused by a cervical swelling. At autopsy the growth had replaced the hypophysis, grown through the base of the skull into the pharynx and produced extensive cervical metastases. The other cases referred to as belonging in this group are those of Schwab (1913), Masera (1910), Mensinga (1897), and Rothmann (1892).

From all examples of squamous epithelial tumors or cysts of the hypophyseal duct should be differentiated the *cysts* arising from *Rathke's pouch, i.e.,* the *cleft* between the anterior and posterior lobes.

In the following paragraphs other exemplary cases from the literature may be cited and the cases described in this paper discussed and correlated with the classification suggested above.

1. *Benign squamous epithelial papillary cyst, or intracystic papilloma* of the hypophysis or infundibulum. Example: Case I described in detail above. Two cases briefly reported by Cushing (1912) also belong in this group. One of Cushing's cases was a walnut-sized bilocular infundibular papillary cyst filled with a gelatinous substance (after fixation *in situ* with formalin), projecting from the wall of which were numerous verrucous nodules composed of squamous epithelium. The other cyst was larger but of the same gross characters. It seems that these two cases of Cushing represent the simplest form of these tumors, since there was no real papillary growth, but only a few small verrucous excrescences. Cushing (page 289) advanced the hypothesis that "these papillary infundibular cysts" may arise, owing to "developmental aberrations," which "may occur in relation to the neurohypophysis," *i.e.,* the posterior lobe. Cysts of the posterior lobe, however, are rare and usually result from extensions (which may later be cut off) into the posterior lobe of cysts arising from relics of Rathke's pocket, and are lined, as a rule, by ciliated columnar epithelium (*vide infra*).

Case I of this series is of a type corresponding with Cases VI and VII reported by Erdheim in 1904. The latter were Vienna museum specimens with the dates May 23, 1848, and November 28, 1868, respectively. Erdheim's tumors both arose apparently from rests in the infundibulum, the hypophysis was flattened but not destroyed or incorporated in the cyst wall and hung by its pedicle polyp-like below. Erdheim collected a number of cases from the literature in which the cystic tumor was lined with stratified squamous epithelium, but only the cases of Wagner (1861), Cornil and Ranvier (1881), Selke (1891), Langer (1892), and Fahr (1903) showed an intracystic papillary structure resembling that of the case presented above. Often in the literature the term *papillary* is applied on account of small squamous-cell excrescences. Frequently in the reported cases desquamation has occurred to such an extent that only traces of

squamous epithelium remain. Neither of Erdheim's two cases showed such extensive proliferation of pedunculated intracystic papillary masses, or stratified squamous epithelium with such well-preserved characters.

The case of Selke (1891) may be briefly abstracted here because it had the same extensive intracystic papillary morphology and at the same time illustrates a source of error in the pathological diagnosis of these particular tumors.

In a forty-two-year-old woman who died following trepanation, the third ventricle was found dilated and filled with a cauliflower-like mass, which involved the floor of the ventricle and extended through the *foramina Monroi* into both lateral ventricles. The villous-like masses composing the tumor were composed of stratified, non-keratinized epithelium, seated on a strong connective-tissue framework. At the base of the brain the tumor arched forward, dragging the chiasm, and was overlaid with pia. The latter also extended directly into the connective-tissue framework of the papilloma. Selke diagnosed "a papilloma arising from the ependyma of the third ventricle floor," and decided that the squamous epithelial rest from which it arose entered the third ventricle during fetal life, when the infundibular region was in intimate relation with the buccal cavity. Erdheim pointed out the thinness of the roof of the cyst in one of his own cases (Case II), and attributed the ventricular involvement in Selke's case to a breaking through of the papilloma mass into the already highly raised third ventricle. That such a mechanism is easily possible may be appreciated from a study of Case III (*vide supra*), and a glance at the photographs in Figs. 14 and 15.

2. *Benign or locally malignant adamantinomatous cystic or solid tumors, of the hypophysis or infundibulum,* often with calcification, not infrequently of "autochthonous teratoid" character, occasionally with basal-cell epithelioma differentiation.

The largest number of hypophyseal duct tumors fall in this group. Cases II and III reported above belong here. The structure shown in the tumor of Case II may be taken as characteristic of the simpler forms of adamantinomata, although the histological possibilities of this tumor should not be considered exhausted by the examination of the fragment of the cyst wall removed at operation.

The resemblance of these tumors to the adamantinomata of the jaw was first noted by Onanoff in 1892, who had in mind the classical work of Melassez (1885). Adamantinomata of whatever location produce a structure which tends to reproduce the essential features of the *enamel organ.* In the histological description above (Cases II and III) the columnar peripheral layer of the neoplastic epithelial processes corresponds with the so-called *inner layer* (of *adamantoblasts*) of the enamel organ, the subcolumnar transitional zone of vesicular epithelial cells with the *intermediate zone,* and the reticulated hydropic central zone of *stellate* epithelial cells with the enamel pulp or middle zone of the enamel organ, respectively. (That such a tumor may develop elsewhere is possible. Ewing (1919, p. 694) quotes B. Fischer as describing an adamantinoma involving the cortex of the shaft of the tibia. For the origin of this tumor a down-

growth of embryonal ectoderm was assumed to have penetrated the tibia and differentiated as enamel organ, just as the gingival epithelium does after penetrating the maxilla.) Mallassez demonstrated larger numbers of squamous epithelial-cell "rests" of the enamel organ in the normal mandible, and to these rests, which he designated "*débris epitheliaux paradentaires*," assigned the origin of the mandibular adamantinomas. Furthermore, he interpreted the presence of these cell groups as analogous with the rich dental apparatus of some lower vertebrates and as giving rise to the supernumerary teeth of the so-called third dentitions in the human.

In view of the probable origin of at least some of the *dentigerous* cysts of the jaw (Hildebrand, quoted by Ewing) from structures resembling the enamel organ, it is interesting to note the hypophyseal tumor of suggestive adamantinomatous histology in a seventy-seven-year-old woman reported by Beck (1883) in which a number of actual teeth were present. Thus oncologically one might consider every adamantinoma as a potential producer of teeth. The reader is referred to Beck's article for a collection of cases of true teratomas of the hypophysis. Many of these were associated with epignathi.

The hypophyseal duct adamantinoma produces masses of dead stratified epithelium varyingly calcified. These necrotic cell masses by some (Farnell and Lambert) have been compared to abortive enamel prisms. In unusual instances (Case IV of Erdheim and Case III of the writer) this dead epithelium may be partially replaced by bone.

The not infrequent resemblance of hypophyseal duct tumors to various cutaneous epitheliomas is interesting. The case of Bruce and MacKay (1909) bears a striking resemblance to the frequent basal-cell epithelioma of skin, as also do certain areas of the tumor of Case II described above. It was noted by Erdheim that a rarer epidermoid derived tumor which is located subcutaneously, the so-called calcified epithelioma of the skin, is interestingly similar to the hypophyseal duct tumors which undergo calcific and osseous changes.

Case III is a typical example of the adamantinoma-like tumors arising from squamous-cell inclusions, in which, however, degenerative and regenerative biological processes are active. Consequently, it exhibits a structure more complex and worthy of more careful study than the tumor of Case II. Possibly some pathologists might at once designate such a tumor a "teratoma." However, it consists entirely of squamous epithelium and its associated stroma which have undergone progressive and regressive changes. The epithelium has by degenerative or metaplastic changes produced a sebaceous-like epithelium, but no sweat glands or hair follicles. In a small localized area there was some hyperplasia of squamous epithelium showing malignant characteristics which, however, could scarcely have any general malignant significance. Extensive areas of dead, keratinized, partly calcified epithelium were present as a result

of regressive (degenerative) changes. In places these had excited a foreign body reaction on the part of the stroma with production of osteoclasts and osteoblasts and resultant actual bone formation about the partly calcified masses of dead epithelium which were being absorbed. The presence of such osseous tissue where the successive stages of its production can be followed as above indicated with no suggestion of attempted formation of skeletal bony structures does not suggest a congenital osseous anlage. Neither do the connective tissue elements seem present in other than the rôle of stroma. No smooth or striated muscle was found or reproduction of the histology of any somatic glandular elements. A tridermal composition cannot be demonstrated.

Recently an interesting study concerning the formation of bone in calcified epithelial tumors was made by G. W. Nicholson (1917), who studied the formation of bone in a calcified subcutaneous epithelioma (the so-called calcified epithelioma of skin) which had undergone osseous changes. Nicholson was concerned with interpretation of the conversion of pavement epithelium into bone. He was able to show that this took place not by "metaplasia," which is a direct substitution of the cells of one tissue for those of another, but by an indirect process involving several steps, essentially as follows: (1) Death and calcification of the epithelium; (2) proliferation of granulation tissue; (3) formation of foreign body giant cells; (4) a dissolving out of the calcium salts of the epithelium (solvent action of CO_2 as correlated with the hypothesis of Hofmeister (1910): oxidation in the case of the giant cell being rapid); (5) formation of osteoblasts from the fibroblasts of the granulation tissue, stimulated by the concentrated solution of lime salts which has been diffused out of the giant cells; (6) formation of the bony matrix by hyalinization and calcification of the connective tissue fibres. The all-essential factor in this series of steps is the presence of lime salts. The phenomenon is shown clearly to be similar to the normal process of ossification in cartilage (skeletal), the calcified epithelium being comparable with cartilage, the stroma with the bone marrow. In Nicholson's epithelioma of skin the stroma in places somewhat resembled normal bone marrow.

Another interesting histological feature of the tumor of Case III was the finding of typical keratohyalin granules. These were thought by Erdheim to be absent in hypophyseal duct tumors and present only in cholesteatomas. In the tumor of Case III they were found in relatively limited areas in a few of a large number of sections of many different blocks, so that if only a small bit of tissue was available they might not be found. They have been demonstrated before in the cases of Bartels (1906) and Strada (1911), although Jackson (1916) without reference to their findings states that they do not occur in hypophyseal duct tumors. Some weight was attached by Erdheim to the presence or absence of keratohyalin granules in the differential diagnosis between cholesteatomas and tumors of hypophyseal duct origin. That these granules were

not demonstrated in some of Erdheim's cases possibly is related to the age and preservation of the specimens, several of which had rested on the museum shelves of the Vienna University for decades.

Cysts of Rathke's Cleft.—A type of cyst (*cf.* Case IV) which should be differentiated from those of squamous epithelial origin arises from Rathke's cleft or residual diverticuli of Rathke's pouch, and is lined by cylindrical (often ciliated) epithelium. Similar cysts may, indeed, arise from traces (*ependymal*) of the formerly existing canal of the posterior hypophyseal lobe. A third origin suggested for these cysts is from "colloid containing glandular epithelial tubules" (Weichselbaum, 1879) in the region of Rathke's cleft, but in this case the lining is not of ciliated epithelium. These cysts are usually "colloid containing," although this can scarcely be of much differential value, and microscopically the lining cells may show colloid droplets. Such cysts are usually small, up to that of a cherry seed, and usually intrasellar. In general, one may say that unless there is strong reason to suspect an ependymal or colloid glandular (*i.e.*, from acini of the pars anterior) origin for such cysts (Case IV) lined with a single layer of ciliated columnar epithelium they may properly be attributed to an origin from the cleft or from a diverticulum of the pouch of Rathke. It is a mistake, on the other hand, to designate to squamous epithelial-lined cysts an origin from Rathke's cleft, since the latter in the fully developed hypophysis is lined only with a single layer of columnar or cubical epithelium. It may be borne in mind that in intracystic papillary squamous epithelial cysts where much desquamation has occurred a cylindrical change may rarely be present (Erdheim), but in fresh or well-preserved specimens this is usually of limited occurrence and associated with other areas of typical squamous epithelium. An origin from Rathke's pouch was erroneously ascribed to the tumors of Cases I and III (above) by other observers.

SURGICAL CONSIDERATIONS

Prognosis.—There is an important surgical consideration directly dependent upon the correct recognition of hypophyseal duct tumors. In the past at operation the neurological surgeon who has explored a suprasellar growth in intimate relation with the third ventricle above, has often thought it derived from the third ventricle. Hereafter on microscopic examination of tissue from the base of a suprasellar cyst (at operation or between operations) the surgeon, after ascertaining the squamous epithelial cell nature of the cystic tumor, may be certain that it is of extra-ventricular origin, and this will guide him in subsequent operative procedures, in the course of which it will be of great importance to him to realize the delicate character of the cyst wall in the neighborhood of the third ventricle floor (*cf.* Figs. 14, 15, and 16), which may otherwise be ruptured in attempts at removal of the lining of the cyst, as the wall between the cyst cavity and third ventricle cavity may consist only of a thin mem-

brane (Case III of the writer, Cases II, III, and IV of Erdheim, and others).

The suprasellar location of the majority of hypophyseal duct tumors may be emphasized. Five out of seven of Erdheim's original series (1904) of tumors developed in the infundibulum, but the entire seven had extended above into the intracranial cavity. Two out of three of the writer's cases arose above the sella (infundibulum), the third arising in the upper part of the anterior lobe, but presenting above the sella in the course of its development. Therefore, in this group of tumors an intracranial mode of approach similar to that devised by Heuer (1918) seems particularly applicable. By no other means than an intracranial approach can the majority of them be properly attacked, and by this route the chance of destroying the hypophysis itself is obviated.

It is entirely possible that the prognosis of these cases may be entirely altered within the next decade. So far as I know at present among this group only the case of Kanavel has survived for over three years and retained his working efficiency. Kanavel's case apparently developed within the sella, since it was successfully attacked transphenoidally. Symptoms having returned after the first two operations, Kanavel applied a tampon of tincture of iodine which was left in for twenty-four hours. This vigorous treatment apparently destroyed the epithelial lining of the cyst. The subsequent history of this patient will be of great interest.

Associated Endocrinopathic Effects.—In addition to the gross somatic change of adiposity which, together with its allied concomitants of the syndrome of Fröhlich, have received the attention of numerous observers, marked histological alterations were present in the genital organs of two of the above considered individuals. Of these the senile changes in the endometrium of the adolescent (Case III) are the rarer and perhaps more interesting, although the histological picture of testicular atrophy in the individual of Case I is of striking distinctness.

Case III was a young married woman in whom amenorrhœa was established over three years before death, being in effect the first symptom. Following the establishment of amenorrhœa her weight had increased from 100 to 130 pounds. At the autopsy the ovaries contained cysts but no corpora lutea, numerous primordial follicles, but no nearly mature follicles. In one tube there was an early tuberculous lesion, the other being perfectly free. Histologically the uterus showed a striking *atrophy* of the endometrium (Fig. 30, U) comparable with that of a senile endometrium.

The endometrical atrophy seems to have been immediately dependent upon the cessation of ovulation and absence of *corpora lutea.* The latter in turn seems dependent upon the intracranial condition. Cushing (1912) has attributed such effects to a shutting off of the secretion of the posterior lobe into the cerebrospinal fluid *via* the infundibulum and third ventricle. Subsequent investigators have questioned his results in the demonstration of such a secretion in the cerebrospinal fluid. In this case

the hypophysis showed gross pressure effects, but no correlative histological changes of note.

Histological changes in the thyroid, adrenal, and pancreas were not apparent.

In Case I, a white male, married, thirty-five years old, the patient had regarded his *libido sexualis* as "a little below normal," before the onset of headaches and loss of vision, but after these symptoms appeared his loss of *libido* became complete. In this instance the tumor had developed in the upper part of the anterior lobe and the latter was flattened out saucer-like below but incorporated into the wall of the cyst. The apparent displacement of anterior lobe tissue into the wall of the cyst is so striking as to suggest a glandular transplant in which the blood supply has been preserved and the transplantation gradually effected. The localized necrosis of anterior lobe cells in the wall of the cyst was limited in extent, evidently a recent occurrence, possibly related to the exploratory operation, and could have borne no causal relationship to the testicular changes of long duration.

The testes, of normal size, showed a striking atrophy of the spermatogenous epithelium and absence of spermatogenesis with persistence only of the supporting (Sertoli) cells. The interstitial cells of Leydig were reported present in normal numbers. The interstitial fibrous tissue was increased.

The other glands of internal secretion showed no striking changes. Thymus tissue (15 or 20 grams) was present, but consisted very largely of fat and histologically was evidently a regressive thymus. The origin of the testicular changes is complicated by the presence of clinical serological evidence (positive Wassermann tests on spinal fluid and serum) of syphilis. There are no miliary gummata in the testicle, but occasional small areas of round-cell infiltration. In view of the absence of luetic history (although he confessed having had a urethritis several years before), together with the coincidence of impotence and onset of his intracranial symptoms, it seems that the changes in the testes are probably dependent more upon the tumor than upon a syphilis which left no definite mark. Somewhat similarly in the papillomatous intracystic tumor of Fahr (1903) there was no evidence of other than a coincidental relationship between the tumor and an organic lues.

In Case II, a female child eleven years old, there was no necropsy, but clinically the case is interesting because there is no apparent retardation of secondary sexual characters; on the contrary, they seem slightly accelerated (Fig. 9).

CONCLUSIONS

1. Although there are embryological possibilities for growth of squamous epithelial neoplasms between the pharynx and the sella turcica, the great majority of such tumors develop from squamous epithelial em-

bryonic rests of the hypophyseal duct either in the infundibulum or beneath the upper surface of the anterior lobe of the hypophysis. *Of either origin the tumor usually presents above the sella.*

2. In view of the fact that a majority of these tumors are suprasellar in position from the beginning and that nearly all early assume this position, it appears that they are especially suitable surgically for an intracranial approach. In tumors which arise beneath the capsule of the anterior lobe (*cf.* Case I) the latter becomes flattened out below and a transsphenoidal approach may destroy the entire anterior lobe of the hypophysis.

3. The tumors derived from embryological remnants of the hypophyseal duct are quite different in structure from those derived from Rathke's pouch or cleft (between the anterior and posterior hypophyseal lobes). From the duct *reliquii* develop papillary squamous epithelial cysts (Case I) and solid and cystic, frequently calcified squamous epithelial adamantinomatous tumors (Cases II and III); whereas, from Rathke's pouch or the cleft develop simpler cysts lined by a single layer of ciliated cylindrical epithelium (Case IV).

4. The hypophyseal duct tumors histologically may be divided into *three groups*. *Group I* is that of the papillary cyst or intracystic papilloma (Case I) which is histologically the most benign example of hypophyseal duct tumors. *Group II* includes the uncalcified or calcified adamantinomas (solid or cystic), the rarer tumors which closely resemble the basal epithelioma of skin (*cf.* case of Bruce and Mackay and Case II of the writer), and the more complicated adamantinomas (Case III), the "autochthonous teratomas" of Ewing. The tumors of this group may show criteria of local malignancy, but do not metastasize. *Group III* comprises a very rare group of cases which show all the ear-marks of malignant spinal-cell carcinoma and may metastasize extensively to the cervical lymphatics (Fahr, 1918).

5. The frequent occurrence of calcification in hypophyseal duct tumors is an important diagnostic fact. At variance with the statement of Jackson (1916) that röntgenography is usually negative, in each adamantinomatous tumor (Cases II and III) described by the writer the röntgenograms showed a suprasellar calcified nodule. The rarity of such calcified shadows in tumors of other types (adenomas, endotheliomas, etc.) makes such nodular shadows almost pathognomonic.

6. The occurrence of bone in hypophyseal duct adamantinomas is not due to the presence of a congenital osseous anlage but is a result of activity on the part of the stroma, apparently excited by the presence of calcium salts which have been deposited in the necrotic stratified epithelium. The mechanism of osseous change is apparently similar to that described by Nicholson for the same phenomenon in calcified cutaneous epitheliomas.

7. Hypophyseal duct tumors of the infundibulum not infrequently break into the third ventricle (*cf.* Case III). To the contrary, the tumors of the ependyma or choroid plexus of the third ventricle are very rarely present in

the suprasellar region; this is explained by spread of the growth along the intraventricular paths of least resistance.

8. During operations on suprasellar cysts in intimate contact with the floor of the third ventricle microscopic demonstration of squamous epithelium from the lining of the cyst will assure the surgeon that the cyst (or solid tumor) originated below the ventricle. A pathological fact of importance for the surgeon to appreciate is the intimate and delicate relation of such cysts with the floor of the ventricle, from which they are frequently separated only by a very thin membrane (Case III).

9. The very frequent occurrence of the clinical syndrome of *dystrophia adiposo-genitalis* (Fröhlich) in patients suffering with hypophyseal duct (squamous epithelial) tumors makes the pathological findings in the genital organs of two individuals (Cases I and III) of particular interest. In the uterus of a twenty-year-old girl (Case III) there was an *atrophic endometrium,* almost equal to that of the senile type, associated with cessation of the process of ovulation (ovaries). The testes of a thirty-five-year-old man showed a marked atrophy of the spermatogenous epithelium.

10. In my study of the literature reports of fourteen additional hypophyseal duct tumors have been found, which when added to the thirty-eight compiled by Jackson in 1916, together with the three cases reported above, bring the total number collected from the literature to fifty-five cases.

In conclusion, I wish to xpress my thanks to Professor W. G. MacCallum of the Johns Hopkins Hospital for the privileges of his laboratory, extended to me for resumption of this work upon my return from overseas. To Dr. G. J. Heuer, Dr. W. E. Dandy, and Dr. M. C. Winternitz I am indebted for the clinical histories and pathological material, and to Dr. F. H. Baetjer for the use of his excellent röntgenograms. The photomicrographs are the result of my own efforts in Professor MacCallum's laboratory.

BIBLIOGRAPHY

Arai, H.: Der Inhalt des Canalis craniopharyngius Anat. Hefte, 1907, 33, 411.

Bartels, M.: Ueber Plattenepithelgeschwülste der Hypophysengegend (des Infundibulums). Ztschr. f. Augenh., 1906, 16, 407, 530.

Beck, H.: Ueber ein Teratom in der Hypophysis cerebri. Ztschr. f. Heilkunde, 1883, 4, 393.

von Bonin, G.: Classification of tumors of the pituitary body. Brit. M. J., 1913, 1, 934.

Bregman, L., and Steinhaus, J.: Zur Kenntnis der Geschwülste der Hypophysisgegend. Virchow's Arch. f. path. Anat., 1907, 188, 360.

Bruce and MacKay: Epithelioma of the Hypophyseal Duct. Rev. of Neurol. and Psychiatry, 1909, vii, 445–455.

Christeller, E.: Die Rachendachhypophyse des Menschen unter normalen und pathologischen Verhaltnissen. Virchow's Arch. f. path. Anat., 1914, 218, 185.

Cornil and Ranvier: Cited by Erdheim (1904).

Cushing, H.: The pituitary body and its disorders. Lipp., 1912.

Dandy, W. E., and Goetsch, E.: The blood supply of the pituitary body. Am. J. Anat., 1910–11, 11, 137.

Ehlers, H.: Ein Beitrag zur Kenntnis der Infundibularzysten des menschlichen Gehirnes. Virchow's Arch. f. path. Anat., 1910, 199, 542.

Erdheim, J.: Zur normalen und pathologischen Histologie der Glandula thyreoidea, parathyreoidea und Hypophysis. Beitr. path. Anat. u. z. allg. Path., 1903, 33, 158.

Erdheim, J.: Ueber Hypophysenganggeschwülste und Hirncholesteatome. Sitzungsb. d. k. Akad. d. Wissensch. Math.-naturw. Cl., Wien., 1904, 113, 537.

Erdheim, J.: Ueber einen neuen Fall von Hypophysenganggeschwülst. Centralbl. f. allg. Path. u. path. Anat., 1906, 17, 209.

Ewing, J.: Neoplastic diseases. Phila., 1919.

Fahr, T.: Papillom an der Basis des dritten Hirnventrikels. München. med. Wchnschr., 1903, 50, 2, 1897.

Fahr, T.: Beitrag zur Pathologie der Hypophysis. Deutsch. med. Wchnschr., 1918, 44, 1, 206.

Farnell, F. J.: An extracerebral tumor in the region of the hypophysis. New York M. J., 1911, 93, 462.

Götzl, A., and Erdheim, J.: Zur Kasuistik der trophischen Störungen bei Hirntumoren. Zeitschr. f. Heilk., 1905, 26, Abt. f. int. Med., 372.

Haberfeld, W.: Die Rachendachhypophyse, andere Hypophysengangreste und deren Bedeutung für die Pathologie. Beitr. z. path. Anat., u. z. allg. Path., 1909, 46, 133.

Harms, H.: Ueber Hypophysenganggeschwülste. Deutsch. Ztschr. f. Nervenheilk., 1914, 51, 438.

Hecht, D'O.: A teratoma of the hypophysis. J. A. M. A., 1909, 53, 1001.

Herring, P. T.: The histological appearance of the mammalian pituitary body. Quart. J. Exp. Physiol., 1908, 1, 121.

Heuer, G. J., and Dandy, W. E.: Röntgenography in the localization of brain tumor. J. H. H. Bull., 1916, 27, 311.

Heuer, G. J.: A new hypophysis operation. J. H. H. Bull., 1918, 29, 154.

Jackson, H.: Craniopharyngeal duct tumors. J. A. M. A., 1916, 66, 1083.

Jordan, D. S., and Evermann, B. W.: Fishes of North and Middle America, 1896, pt. 1, p. 8.

Kanavel, A. B., and Jackson, H.: Cysts of the hypophysis. Surg., Gyn. and Obst., 1918, 26, 61.

Kon, J.: Hypophysenstudien. I. Seltene Tumoren der Hypophysengegend (Teratom, Peritheliom, telangiectatisches Sarkom). Beitr. z. path. Anat. u. z. allg. Path., 1908, 44, 233.

Langer, L.: Ueber cystische Tumoren im Bereiche des Infundibulum cerebri. Zeitschr. f. Heilk., 1892, 13, 57.

Lewis, D. D.: A contribution to the subject of tumors of the hypophysis. J. A. M. A., 1910, 55, 1002.

Luschka, H.: Der Hirnanhang und die Steissdruse des Menschen. Berl., 1860.

Mallassez, L.: Sur le rôle des débris epitheliaux paradentaires. Arch. de Physiol., 1885, 1, 309; 2, 379.

Margulies, A.: Ueber ein Teratom der Hypophyse bei Kaninchen. Neurolog. Centralb., 1901, 20, 1026.

Masera, G.: Ueber eine interessante Geschwulst der Schadelbasis. Virchow's Arch., 1910, 199, 471.

v. Mihalkovics, V.: Wirbelsaite und Hirnanhang. Arch. f. mikrosk. Anat. u. Entw., 1875, 11, 389.

Nicholson, G. W.: The formation of bone in a calcified epithelioma of the skin. J. of Path., 1917, 21, 287.

Onanoff, J.: Sur un cas d'epithelioma. Thèse de Par., 1892.

Rathke, H.: Ueber die Entstehung der Glandula pituitaria. Arch. f. Anat., Physiol. u. wissensch. Med., 1838, 5, 482.

Rippmann, T.: Ueber einen bisher nicht beobachteten Fall multipler Intrafoetation in- und ausserhalb der Shädelhöhle. Inaug. Diss., Zurich, 1865.

Rothmann, M.: Ueber multiple Hirnnervenlahmung in Folge von Geschwulstbildung an der Schadelbasis, etc. Ztsch. f. klin. Med., 1893, 23, 326.

Salzer, H.: Zur Entwicklung der Hypophyse bei Saugern. Arch. f. mikr. Anat., u. Entw., 1898, 51, 55.

Saxer, F.: Ependymepithel, gliome und epitheliale Geschwülste des Centralnervensystems. Beitr. z. path. Anat. u. z. allg. Path., 1902, 32, 276.

Schwab, W.: Beitrag zur Kasuistik der Schadelbasistumoren. Med. Klin., 1913, 9, 291.

Teutschlaender, O. R.: Zwei seltenere tumorartige Bildungen der Gehirnbasis. Virchow's Arch., 1914, 218, 224.

Walker, J. W. T.: A case of primary osteoma of the brain. Reports of the Society for the Study of Disease in Children, 1902, 2, 172.

Warthin, A. S.: A study of the lipin content of the liver in two cases of dispituitarism. J. Lab. and Clin. Med., 1916, 2, 73.

Wegelin, Bericht ueber die Tatigkeit der St. Gallischen naturwisschaftln. Gesellsch., St. Gallen, 1860.

Ziegler, E.: Lehrbuch der speziellen pathologischen Anatomie, 1902, ed. 10, 403.

THE WAR'S CONTRIBUTION TO CIVIL SURGERY*

By Burton James Lee, M. D.
of New York, N. Y.

Published and oral testimony as to the soundness and efficacy of certain new lines of surgical treatment seems to have failed to make its full impress upon the majority of American surgeons. It is highly desirable, therefore, that such a group as ourselves should seriously consider various phases of the surgery of war, inquiring what, if any, application may be made of the knowledge gained, placing this society on record as to its convictions and its practice. Has surgery acquired nothing, leaving its theory and practice just where it was when the war found it? I am of those who believe that a great deal has been given by the war to surgery. This paper represents an effort to find the mind of The New York Surgical Society as to the applicability of certain of the war surgical methods to civil practice. No attempt has been made to cover the whole field, but a certain limited number of topics deemed the most fruitful for discussion have been considered. The following letter and questionnaire were sent to every active member of the Society, numbering seventy, forty-four responding:

Dear Doctor:

I am conducting an inquiry in an effort to find to just what extent certain principles recognized as efficient in the War Zone are being used in civil surgery. If you would be kind enough to answer briefly the enclosed questionnaire I would be very grateful.

I am hoping to make a summary of the questionnaire answers in a paper to be read before the Society in January. Will you, therefore, respond at the earliest convenient moment.

Sincerely,

QUESTIONNAIRE

1. To what extent do you practice primary closure of compound fractures of extremities? Do you approve the principle?
2. To what extent do you use the principle of secondary closure of soft-tissue wounds? Do you approve the principle?
3. To what extent do you use the Carrel-Dakin solution and technic? Do you approve the principle?
4. To what extent do you use the principle of immediate active mobilization in post-operative joint conditions? Do you approve the principle?
5. To what extent do you use the principle of active mobilization in septic joints? Do you approve the principle?

A summary of the various replies to these questions presents the following results:

---

* Read before the New York Surgical Society, January 14, 1920.

1. To what extent do you practice primary closure of compound fractures of the extremities? Do you approve the principle?

Five men absolutely opposed the use of this principle. The majority favored its employment in properly chosen cases, and several successful results were reported. In general, considerable wound contamination or extensive muscle injury were considered contraindications to the use of primary suture, and when considerable time had elapsed from the receipt of the injury, caution should be exercised in deciding for primary suture. Some men favored not opening the wound where compounding was small and from within, but others seemed to feel these were above all others the cases to open, as being most favorable, and the writer agrees with the latter opinion. Careful *débridement* of all soiled and devitalized tissues was recognized as essential to a successful result, such dissection including cleaning of the bone-ends when soiled. Several preferred to always make use of Carrel-Dakin wound treatment followed by delayed primary or secondary suture. All agreed that when in doubt as to the dissection having been successful in obtaining a clean wound, primary suture had best not be employed. The more accurate one's *débridement*, however, the less doubt there will be in the surgeon's mind as to the degree of wound disinfection accomplished.

We may then fairly conclude that the practice of primary closure of compound fractures is sound and that the principle is approved, but that the cases should be carefully selected and the surgery well done to achieve success.

2. To what extent do you use the principle of secondary closure of soft-tissue wounds? Do you approve the principle?

The writer has made no attempt to differentiate sharply between delayed primary suture (six to eight days) and secondary suture (any time later) as to indications or technic, as these have been completely discussed in the war literature.

With one exception, there was absolute unanimity in favor of secondary suture and the principles underlying its use, this decision, however, being conditional upon having in hand a Carrel-Dakin supply and technic beyond criticism. The exception noted made use of the procedure "only to avoid subsequent cicatricial contraction."

The Society as a whole, therefore, places itself on record as almost unanimously favoring secondary suture.

3. To what extent do you use the Carrel-Dakin solution and technic? Do you approve the principle?

There was but one viewpoint concerning this question, and that an enthusiastic one for the principle and use of wound sterilization by the Carrel-Dakin technic. The only differences of opinion were those as to its scope, and all appreciated the difficulties of obtaining a faultless technic. The Society is apparently unanimous upon one point: only the accepted technic or none at all. Culture control and bacterial charts are

essential to the proper use of the method. It was very gratifying to receive such statements of approval as the following: "As one who has witnessed the transition from antiseptic to aseptic surgery twenty-five to thirty years ago, I regard the demonstration of the fact that septic wounds can be sterilized without damage to the tissues, as the greatest contribution to surgery that the war has made. I do not understand why many able surgeons do not recognize the *new* principle involved in the Carrel-Dakin treatment"; also, "I use the Carrel-Dakin treatment in practically every case of infection." "I look upon the treatment as one of the great advances in surgery"; and, "one of the most important additions to modern surgery."

Certain special points of interest were brought out in the questionnaire.

a. Two large hospital services have practically abandoned the use of the technic because it seemed impossible to provide proper apparatus and solution, and technical difficulties seemed insurmountable. I believe that this Society should stamp any general service where the technic cannot be applied for the reasons stated as not measuring up to the standards of first-class surgery.

b. Two men whom I presume have had but limited experience with the Carrel-Dakin technic felt that surgery alone or surgery plus moist saline dressings gave equally good results. I can only say that experience with a real Carrel-Dakin technic will be the only convincing argument needed for their conversion.

c. As to its use in intra-abdominal abscess cavities, the Society's opinion was divided.

The New York Surgical Society is, therefore, almost unanimously for wound sterilization by the Carrel-Dakin method done properly, and the hospitals of this city must provide apparatus and accurately made solutions, and the surgeons must insist upon faultless technic, that the method may be really available. Following proper surgery, it may, therefore, be used in—

Compound fractures which are unsuitable for primary closure.

Lacerated wounds of soft tissues.

Acute cellulitis.

Osteomyelitis, and

Empyema.

The Carrel-Dakin technic is perhaps the greatest contribution of the war to civil surgery, and it is applicable to numerous groups of cases, both as a prophylactic against infection or to accomplish wound sterilization in the presence of established infection.

4. To what extent do you use the principle of immediate active mobilization in post-operative joint conditions? Do you approve the principle?

The writer, in September, 1918, and again in June, 1919, endeavored to bring home to American surgeons the full significance of Willem's joint surgery, and other writers have added their testimony, but many here in

America still seem ignorant of its principles. Willem's method of immediate active mobilization is thoroughly applicable in civil surgery. It may be used in most of the surgery upon clean joints, such as for movable cartilage of the knee-joint or excision of a small fractured carpal bone or after a traumatism with penetration of a joint, or even, with caution in fracture of the patella. It may also be employed successfully in intra-aritcular fractures without separation and of slight extent. Its use is contraindicated, however, when joint fractures are extensive, or with tendency to displacement, and also in tuberculous joints. The measure then should be applied with judgment.

The motion should be *active* and *immediate* and *frequently repeated*. After the treatment has been instituted, the active motion must be carried out at two-hour intervals in the presence of a nurse or doctor, and the patient is wakened two or three times during the night and encouraged to move the joint.

Two of the members favored passive, rather than active motion, but Willem and Delrez have shown that the latter traumatizes joint tissues less than the former and the degree of pain guides the patient to the limit of active mobilization. *Immediate* active motion may be interpreted to mean any time within the first six post-operative hours, for it is sometimes impracticable to begin earlier, as the patient may hardly be in condition to accomplish much that is really worth while. *No splint* is applied. The dressings over the joint should be loose and no larger than are necessary to insure wound protection and allow for drainage absorption. When feasible, the use of adhesive straps assures the least possible limitation of motion. A tight, large dressing makes any degree of active mobilization impossible. With a knee-joint operated upon for movable cartilage the patient is up and about the ward with crutch support upon the fourth post-operative day and restoration of function may be accomplished in about three weeks.

The results obtained abroad, in those hospitals where the principles were carefully followed through, gave excellent results and justified the enthusiasm of Willem, Delrez, and others for it. Some of the members seem to be wavering between doubt and disapproval as to the efficiency of the method, but experience with the measure must convince them.

It may be said, then, that the majority of the members of this Society are in favor of Willem's method, in dealing with clean joint operations.

5. To what extent do you use the principle of active mobilization in septic joints? Do you approve the principle?

When Willem's method is applied to suppurating joints we have a traditional established mode of treatment thrown rudely into the discard. Many surgeons cannot believe that moving an inflamed septic joint will help the condition and frequently cure it. Some stand aghast and will not or cannot believe. Ten of our members are absolutely opposed to the use of this principle, and a few quotations will illustrate their attitude.

"To my mind to move an active suppurating joint is to add insult to injury. Drainage, rest, and proper local treatment seem to me to be imperative."

"This does not appear to me as reasonable while the process is active nor even when the process has become subacute. After the acute infection has been brought under control and also the swelling and local heat have gone away, then I believe in limited motion every day."

"Not until activity of infection entirely subsided."

"We have had no extended opportunity to practice this type of case. I am not convinced that the principle is sound."

"No experience would doubt its general applicability."

"I confess, however, to a certain amount of fear."

"I would move the elbow in all cases, but not the hip or the knee."

Willem recognized that the only adequate drainage of a septic joint is accomplished by moving it and continuing to move it, lateral openings being the ones usually employed. Active motion will really give the best possible drainage, while immobilization, drainage tubes, and irrigation cannot accomplish this result. I have seen many men with suppurating knees walking about the wards at La Panne with normal knee-joints as regards function and perfectly painless joints, with a thin stream of pus running through the dressings covering their joint wounds and down their legs. These cases were impressive and absolutely convincing. The method is sound, and the experience in practicing it has furnished the proof. It represents a distinct advance in the treatment of septic joints, and it is thoroughly applicable to civil surgery.

The result of our inquiry, therefore, has shown that these types of treatment considered, representing a part of the war's contribution to civil practice, are heartily approved by the majority of the membership of the New York Surgical Society. Only by a thoughtful assimilation and application of such knowledge as the war has developed may the science of surgery truly progress.

SEHRT'S METAL TOURNIQUET FOR PRODUCING ARTIFICIAL ANÆMIA

By Willy Meyer, M.D.
of New York, N. Y.

In the summer of 1916, while looking over some foreign medical literature which, at that time, reached our shores rather sporadically, a brief article of Sehrt's,[1] of the University of Freiburg, entitled "A New Method of Producing Artificial Anæmia" attracted my attention. The author's description of the application of the method greatly appealed to me, and I immediately ordered the instrument through the Kny-Scheerer Company of New York City. Soon after our country entered the war, and the order was not filled.

In the fall of last year, the firm inquired whether I still wanted the tourniquet, to which I replied in the affirmative, and so the instrument reached me in December, 1919. I did not have a chance to try it until early in February of this year, first in a case of amputation of the thigh in its middle, and soon after in an operation for a twice-recurrent sarcoma of the thigh in its posterior aspect. I was so much impressed with the usefulness and simplicity of the device that I made up my mind to present it before the New York Surgical Society.[2]

Since that time I have further employed the tourniquet many times in operations on upper and lower extremities to my entire satisfaction, in no instance did it fail, in no case did it produce a pressure-paresis of one or more nerves of the brachial plexus at the arm.

The tourniquet, made of the best steel, has the appearance of a clamp. The two arms are rounded and bent up at the end; they can be separated sufficiently wide to slip over any size of extremity—thigh or arm (Figs. 1 and 2)—and cross each other when tightened; a thumb-screw, moving on a serrated rod, forces them together as tightly as desired. It can be applied as quickly as these words are spoken, and any ordinarily intelligent person can put it to use. The arms of the instrument are covered with rubber tubing—in emergency cases with cotton or gauze—before the operation, when it is sterilized with the other instruments. It can be placed in position, always within the sterile field, away up at the crotch (Fig. 3) or close to the axilla, best over a piece of gauze or a folded towel wound around the limb (Fig. 4), with the same ease as further down on the extremity. If during an operation the constriction is found too loose, a turn or two of the screw of the instrument, which is covered by the sterile drapings, will make the artificial anæmia complete. When the

[1] Münch. med. Wochenschr., May 25, 1916.

[2] At the meeting of March 10, 1920, see page 386, Annals of Surgery, Sept., 1920.

main vessels have been tied, the screw is loosened by turning it to the left until the vessels not yet secured begin to bleed. Should the bleeding be alarming a few turns of the screw to the right will easily and instantly tighten the grip of the limbs of the instrument upon the extremity. Before the dressing is applied the tourniquet is, of course, removed.

On looking over the latest American literature, I found that Dr. P. E. Truesdale, of Fall River, Mass., has described this same device in the *Jour. of the Am. Med. Assoc.* of January 31, 1920. He states that when the Germans had evacuated the Saint Mihiel salient this instrument was found in one of their advanced post surgical hospitals and given to him for trial. He used it many times and found it " simple to adjust, safe in its effect on the tissues, definite in its control of bleeding, and very adaptable for the purpose in operations on the upper and lower extremities." The instrument was sent to the office of the chief surgeon, and Doctor Truesdale did not see it again. However, he recalled the principle of the design and had one made by Codman & Shurtleff, of Boston, slightly modified, with heavier arms and an oblong slot in the centre of one handle, through which passes the adjustment screw (Fig. 5). This part of the instrument is slightly curved, so that when the thumb-screw is firmly adjusted with the tourniquet in position, the adjustment screw may be shifted forward, releasing compression, and back again for renewed control of hemorrhage should this be necessary (Fig. 6). In the original German instrument the thumb-screw itself has to be turned to the right or left in order to tighten or loosen the compression, as mentioned above.

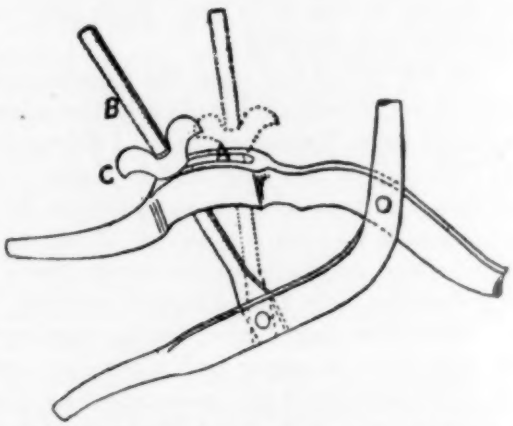


FIG. 6.—Modified handles of tourniquet. *A*, slot through which adjustment screw *B* passes; heavy lines represent adjustment screw holding clamp in position of compression with thumb-nut *C* set; broken lines represent adjustment screw shifted and compression released. (From Journ. Am. Med. Assoc., Jan. 31, 1920, p. 316.)

The principle of this type of compression certainly seems to be ideal. The tourniquet, enlarged or reduced in size, according to the local needs, ought to work equally well in other parts of the body. Recently a tourniquet of larger size (abdominal clamp) was successfully applied " by a nurse " in compressing the abdominal aorta in a case of severe post-partum hemorrhage (*Centralbl. f. Gynäkol.*, No. 1, 1920).

At present I am personally engaged in constructing a number of metal tourniquets of very small size, on basis of Sehrt's principle, for the compression of the pedicle of the lobe of the lung in lobectomy, in order to get full surgical control of the pulmonary stump in this operation. With

FIG. 1.—The original Sehrt metal tourniquet, opened.

FIG. 2.—The instrument closed; the arms covered with heavy rubber tubing.

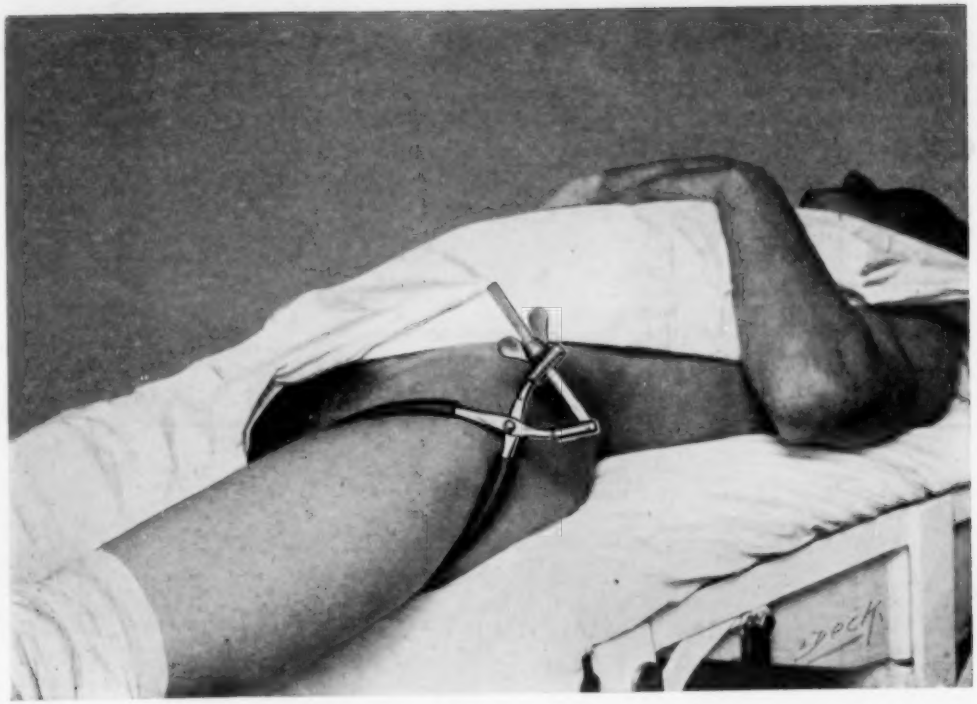


FIG. 3.—Tourniquet switched over thigh, close to crotch.

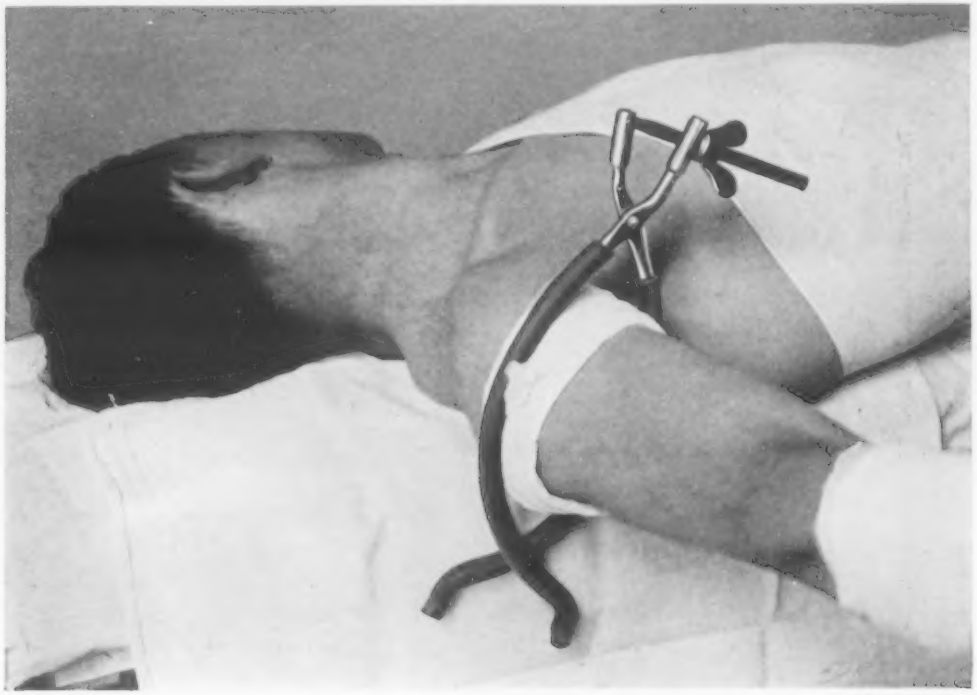


FIG. 4.—Compressing the vessels of the arm.

FIG. 5.—Truesdale's modification of Sehrt's tourniquet.

such a tourniquet in place we should be able to tie securely and, if desired, individually, its compressed vessels after amputation of the lobe of the lung, and also—by means of the gradual release of the compression—to find those that have not yet been secured. We should then likewise be able to deal with the stump of the bronchus as may be deemed fit. I hope that such procedure may contribute to a gradual reduction in the still high mortality of this important and often absolutely imperative operation.

At all events, there can be no doubt that Sehrt's metal tourniquet as described above represents the greatest advance made within recent years as regards effectiveness and ease of producing artificial anæmia. Whoever has experienced the annoyance of Esmarch's elastic bandage or tube, particularly on applying or loosening it near the gluteal fold before and during an amputation of the thigh, will be glad of this simple, efficient, and absolutely reliable substitute.

BOOK REVIEWS

PLASTIC SURGERY OF THE FACE. By H. D. GILLIES. Oxford University Press. London. 1920. Cloth, Quarto, pp. 408.

In this book the author presents the results of his experience in dealing with war injuries of the face, as the surgeon in charge of the department for plastic surgery in the Queens Hospital, Sidcup, during the recent World War.

The abundance of material which forms the basis of this book is very great and the skill and industry with which the various problems involved in dealing with such injuries have been met, is most striking and commendable.

A series of eight hundred and forty-four illustrations make a clear, graphic record of the work done both as regards its various steps and methods and the results obtained. The whole constitutes a most valuable contribution to the medical literature of the war and to the history of surgery. All the possibilities of plastic work evidently have been utilized in the work here recorded, although it is evident that at Sidcup the use of bone transplants and of mechanical devices were resorted to less frequently than in some of the French clinics or in similar cases among our American surgeons.

The book constitutes a storehouse of clinical records which will always merit the careful study of every surgeon who undertakes to remedy by plastic work the deformities of the face, which are often so distressing to the subject and difficult of relief to the surgeon.

LEWIS S. PILCHER.

PLASTIC SURGERY—Its Principles and Practice. By JOHN STAIGE DAVIS. Philadelphia. P. Blakiston's Son & Co. Cloth, Octavo, pp. 770.

In this book the whole field of plastic surgery is covered. For many years the author has specialized in this work at the Johns Hopkins Hospital. The author is of opinion that the time has come for the creation of the new specialty of plastic surgery and advocates the appointment of a specially trained plastic surgeon on the staff of every large general hospital.

Notwithstanding, the greater prominence which the plastic surgery of the face has hitherto occupied, the author claims that plastic surgery of the trunk and extremities is equally important.

The frequent contributions to literature during the last few years by the author has prepared the way for this book, and it should be welcomed as a full and systematic presentation of the possibilities and methods of plastic surgery in all of its departments in all portions of the body. It will be seen that such subjects as exstrophy of the bladder, skin grafting

of all kinds and the tissue transplantations come fully within the scope of this work.

The book is abundantly illustrated and is sure to find a welcome place in the library of every general surgeon.

LEWIS S. PILCHER.

GRAY'S ANATOMY—Descriptive and Applied. Twenty-first Edition, edited by ROBERT HOWDEN, M.A., M.B., D.Sc., Professor of Anatomy in University of Durham. Longmans, Green & Co. London and New York.

An anatomical text-book ought to be crammed full of illustrations each so clear and distinct as to speak for itself. Gray's Anatomy, always well illustrated—the first illustrations were drawn by Vandyke Carter—shows marked improvement in this respect in this latest edition. More than 80 new drawings made by Mr. Sydney Sewell have been added along with others taken from Poirier and Charpey's excellent work. Altogether there are 1215 illustrations in this new edition of which there are 568 colored. The slight coloring aids and accentuates the differentiation of the various structures and impresses their co-relation on the student's mind. The volume would have been still further enhanced in value had it included illustration of head sections, showing the relation of the brain to its external coverings and the best means of gaining access to the brain. For brain surgery such sections are necessary, and even for the student and practitioner desiring to follow localizing symptoms of cerebral lesions, such head sections would much more readily enable them to realize and understand the phenomena.

The omission of such head sections is the more remarkable as this volume gives excellent sections of the upper and lower limbs—showing the structures in a single plane, such as the surgeon would see after amputation, and are useful in many other ways. The editor has been vigilant in keeping abreast of present-day requirements, and has added to anatomical knowledge by bringing into relief points which hitherto were overlooked or considered of little practical importance, but upon which surgical advancements have necessitated accurate information, such as that of the position of the supra-meatal triangle in its relation to the mastoid antrum. The anatomical relations of inguinal and femoral herniæ ought to be improved.

Difference of opinion may certainly be held regarding the introduction of the Basle terminology. It is considered unfortunate to have changed a nomenclature when the editor himself confesses that neither the old nor the new phraseology is entirely satisfactory, and when the Anatomical Society of Great Britain and Ireland concluded that there was no reason for departing from the use of the old nomenclature. Confusion is very apt to ensue. The new terminology may, however, popularize the volume with the Americans who have generally adopted the Basle terminology.

The work generally is very well done. Gray's Anatomy has ever been a favorite text-book with students and practitioners, and this twenty-first edition will assuredly greatly increase its popularity. Credit is due to the Messrs. MacLehose, who have printed this volume. It is produced in a good, clear type with differentiated headings and care has been taken with the illustrations which are remarkably clear and distinct.

WILLIAM MACEWEN.

A MANUAL OF PRACTICAL ANATOMY. By THOMAS WALMSLEY, Professor of Anatomy in Queen's University of Belfast. Longmans, Green & Co.

The present volume of some 180 pages represents the first of three parts into which the work is divided, and deals with the dissection of the upper and lower limbs, containing besides an introduction by the author. The introduction deals with the objects of dissection, the order in which the work is best done, and the nature of structures met with. It is open to question whether the anatomist's view expressed therein, that the student " in the practice of his profession will be called upon to operate on the living body, and a true preparation for this task is careful and thoughtful dissection," will meet with the approval of the teacher of surgery, who often finds the eradication of the " dissecting habit " one of the most difficult tasks in a course of practical operative work.

Each section is prefaced by an order of dissection recommended and time table, and these are followed by a short note on the surface anatomy of the part, and instructions for making the incisions and exposing the parts. The general directions are printed in a bold type and the descriptive matter in smaller type, while reference to the principle structures is facilitated by the use of thick type and an index. The instructions are commendably brief and clear, and the text is supplemented by numerous diagrams.

JOHN A. C. MACEWEN.

FRACTURES. Compound Fractures, Dislocations, and their Treatment, with a section on Amputations and Artificial Limbs. By JOHN A. C. MACEWEN, M.B., C.M., B.Sc., Maclehose Jackson & Coy, Glasgow, 1919.

This is a text-book for students and medical practitioners of 271 octavo pages. The author is a teacher of the subjects discussed, who has taught large classes of students in two of the largest of Scottish general hospitals; and besides his practical acquaintance with these injuries in industrial life, he has to his credit similar experience in the Army in the field during the Boer War and in military hospitals at home during the European War. The teaching inspired by so long and varied experience and practice is simple, direct, and lucid.

The first portion of the book deals with fractures, a brief discussion of fractures in general, growth of bone as affecting healing, and general considerations regarding diagnosis and treatment, being followed by a detailed account of fractures of individual bones. The text is illustrated by outline drawings indicating the sites of insertions of muscles and the directions of the displacing forces. While varieties of splints are freely illustrated and their mode of application carefully described, more recent methods of dealing with such injuries without splints have full justice done them and the cases suitable are indicated.

A similar method is followed in dealing with dislocations, the varieties of dislocation at each joint being considered in detail one after the other, and the various steps of reduction by manœuvre being precisely stated.

A section is devoted to amputations necessitated by compound fracture, and here there is a valuable summary of the newer methods of treating shock, the composition, method of preparation, and mode of giving the various saline or gum-saline solutions being carefully noted, as well as the method of blood transfusion, and the means of determining suitable donors, while the causes of persistent sepsis in the stump are discussed.

In considering the best method of amputating in each individual case, the author keeps in view throughout the necessity of providing "a stump which, when fitted with an artificial limb, will restore in varying degree the usefulness of the damaged limb." With this end in view, amputations affecting the upper and lower extremities are discussed with reference to the possibilities of adaptation of artificial limbs, and modifications as to site of election and detail of method are suggested as the result of improvements effected in the manufacture of artificial limbs, stimulated by the war. The author had abundant opportunities in the Scottish Hospital for Limbless Sailors and Soldiers at Erskine of taking part in these developments, and this text-book profits thereby.

This section of the book is specially well illustrated by plates from photographs, illustrating useful and unsuitable stumps, and various types of artificial limbs, both apart and applied, including the Erskine provisional limb.

An Appendix summarizes the scale of payments for compensation for such injuries under the Workmen's Compensation Act (1906). An unusual abundance of illustrations for a text-book of this size is obtained by full-page plates from photographs, three, four, and sometimes six subjects being combined in one plate without loss of distinctness.

Only the author's long experience in the teaching and practical handling of these subjects could have enabled him to compress so successfully, without sacrifice of needful detail, so much material into a handbook of this convenient size, which an excellent Index renders quickly available.

J. MacGregor Robertson.

X-Ray Observations for Foreign Bodies and Their Localization. By Harold C. Gage, Conducting Radiographer to the American Red Cross Hospital, Paris. Heinemann.

This is a short practical manual which deals clearly with methods of localization, illustrated by numerous diagrams and skiagraphic reproductions. Methods of centring the tube are carefully given, and localization by screen, stereoscopic photographs and tracings, pierced screen, and geometrical localization are described in detail. Localization of foreign bodies in the eye forms a special section. The author describes with particular clearness a method of localization by means of three intersecting lines, which he has developed and perfected, to the success of which Colonel Joseph Blake pays tribute in the preface. There are also short practical dscriptions of the use of the Bergonie vibrator, telephone probe, la Baume Magnetic Finger Cot, auxiliary switch-boards and bromide paper. The book will prove of interest to all who have had practical experience of the difficulties of localizing foreign bodies during the war, and is a good practical manual for those engaged in such work.

John A. C. Macewen.

FIG. 1.—Gross specimen.

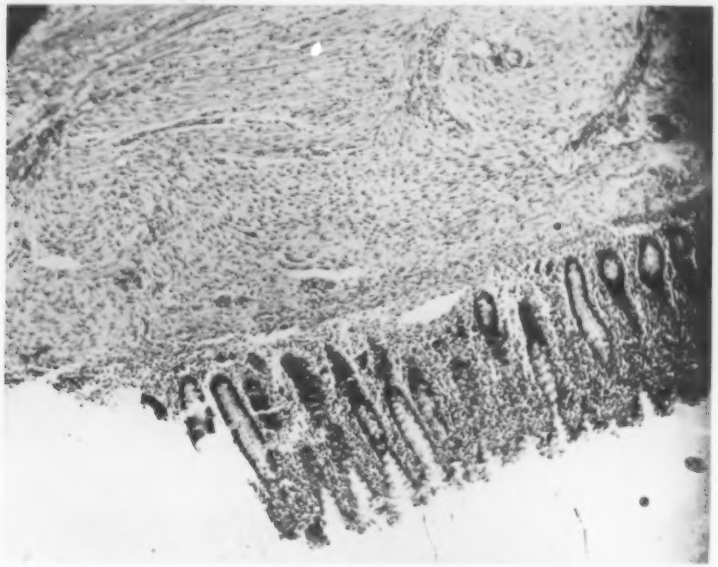


FIG. 2.—Fibromyomatous tissue arising in close proximity to cæcal mucosa (x 50).

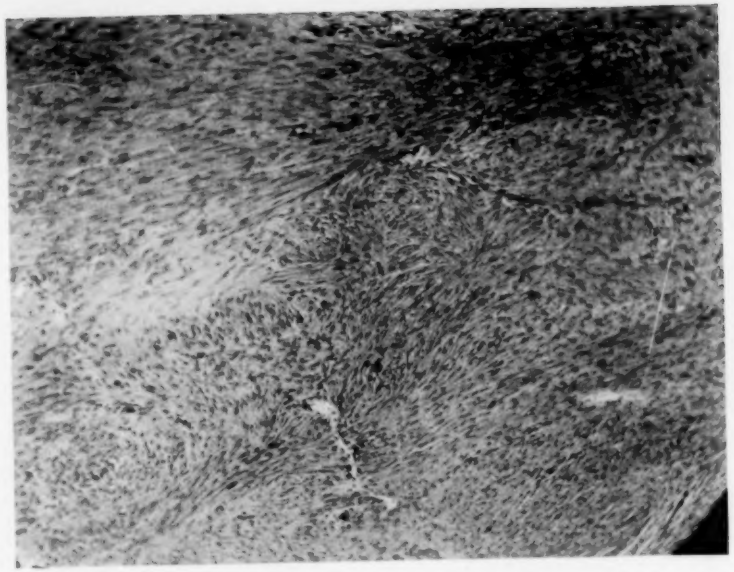


FIG. 3.—Fibromyomatous tissue showing whorls of fibrous tissue (x 50).

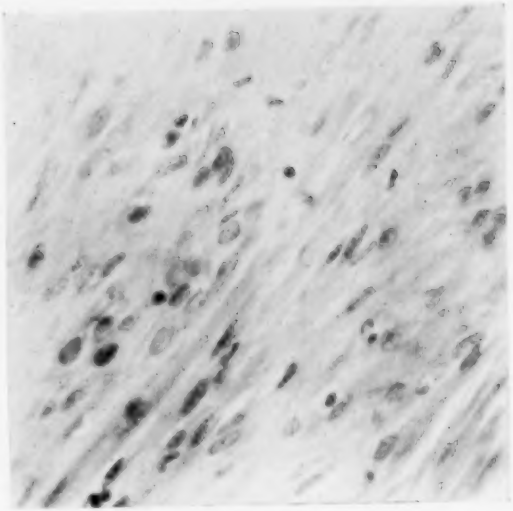


FIG. 4.—Fibroblasts and muscle cells (x 350).

CORRESPONDENCE

FIBROMYOMA OF THE CÆCUM

EDITOR, ANNALS OF SURGERY:

CASE A216159. M. B., a woman aged thirty-six years, was examined in the Mayo Clinic December, 1917. She complained, chiefly, of dysmenorrhœa. During the preceding six months menstruation had been painful, necessitating the use of morphine. There had been no metrorrhagia or menorrhagia; the bowels had always been constipated. On vaginal examination a thickening of the tissues in the right tubal region was felt. At operation the appendix was found to be congested, covered by organized lymph and adherent to the right ovary and tube. The right ovary contained a hemorrhagic cyst; in the left ovary was a simple cyst about 6 cm. by 8 cm.; a right-sided salpingitis and some free fluid in the peritoneal cavity were found. The cysts were enucleated from both ovaries, a right salpingectomy was performed, the appendix was removed, and the uterus suspended.

The patient was well until April, 1920, when she noticed a small swelling in the right groin; this had not apparently increased in size. Her general health was good with the exception of constipation. On examination a mass about 10 by 12 cm. was found in the right iliac fossa. There was no abdominal rigidity and the mass seemed immovable. The urine and blood were negative, but the Röntgen-ray showed a filling defect in the cæcum. A diagnosis of carcinoma of the cæcum was made. The operation showed a hard, firmly fixed tumor about 7 by 7 cm. in the cæcum (Fig. 1). The mass together with 5 cm. of ileum and ascending colon were resected and an end-to-end anastomosis made. The mass was found to be a fibromyoma arising in the cæcal wall. A few of the mesenteric glands showed healed tuberculosis.

Pathological Report.—The specimen consists of an ovoidal, encapsulated, solid tumor situated apparently in the wall of the cæcum, the mucosa and serosa being intact. The tumor is a white fibrous neoplasm surrounded by a capsule consisting of all the layers of the cæcum. Microscopic sections (Figs. 2, 3 and 4) show the layers of the cæcum to be intact, although somewhat thinned out by pressure of the neoplasm which apparently arises in the cæcal muscularis. The neoplasm itself consists of fibroblasts and smooth-muscle cells.

J. A. H. MAGOUN, JR., M.D.,
Fellow in Surgery, The Mayo Foundation, Rochester, Minnesota.

A NEW GASTRO-ENTEROSTOMY CLAMP

EDITOR, ANNALS OF SURGERY:

THE number of clamps on the market for the purpose of gastro-enterostomy is very considerable. So many and varied types have been introduced that, perhaps, mine deserves the term "modification" rather

than new"; but I have not seen one so like it as to disqualify it entirely from the latter title. From the numbers of these clamps one may infer that there is, in general, a lack of satisfaction with them; and most will agree that this inference is borne out in practice. One naturally hesitates to offer an addition to the number. I believe, however, that the clamp I shall describe has certain advantages over those in common use which justify a brief description of it here.

The objects in view in applying clamps during such an operation as gastro-enterostomy are: To prevent the escape of septic contents, to control hemorrhage, and to support the viscera to be anastomosed in a convenient position for that purpose. Thus infection risk is minimized, the advantages of a bloodless operation field secured, and ease and accuracy in suturing facilitated. In order to attain these objects satisfactorily, the clamps used must conform to certain general principles.

The blades must distribute their pressure equally on the surface grasped that no undue pressure be applied at any part, and that no bleeding or slipping shall occur.

The gripping surface must be of a texture that holds well without inflicting damage, in order that a minimum pressure for the control of contents, hemorrhage and slipping may be used.

The two clamps must be capable of easy and close attachment to each other.

Other requirements are ease of manipulation, lightness, convenience in size and form, simplicity, durability, and moderate cost.

The figures illustrate a clamp in the design of which an attempt has been made to carry these principles into effect. Fig. 1 shows the complete instrument. The two clamps are fixed together. Fig. 2 illustrates the clamps separated; one is opened.

1. The inner, rigid and fixed blade.

2. The outer flexible and moving blade. Its flexibility and curvature are so arranged that when closed it becomes straight and presses evenly at all points.

3. Spring of outer blade, by means of which it is automatically adjusted to viscera of any thickness between 0 and ¼ inch, maintaining its parallel position.

4. Hinge, of large diameter to minimize wear and side movement.

5. Screw, which can be folded down parallel to the blades for withdrawal of the clamp after the anastomosis is complete (Fig. 3).

6. Split, milled nut, and thimble. This slips freely over the thread until it is brought into contact with the blade, which the left hand is holding closed in position; the thread then engages and it is fixed with half a turn. There is thus no tedious screwing up. These split nuts and thimbles are largely used on engineers' calipers, and are very convenient for the present purpose.

7. Undercut, sliding attachment for approximation.

8. " Patent fastener " clip, such as one sees on the wrist of a glove. This completes the simple fixing mechanism.

Fig. 3 shows the clamp in use. The anastomosis is complete and the blades opened ready for withdrawal.

I should like to mention some points of comparison with clamps generally used for anastomosis operations.

With the usual " scissors action " clamps it contrasts to advantage as regards parallelism of blades and even distribution of pressure, and these points are of vital importance in securing adequate control of hemorrhage and slipping, without causing bruising at some part. The accompanying diagrams illustrate this. A thick viscus, such as hypertrophied stomach, is supposed to be grasped. A single arrow (↓) indicates correct pressure; two arrows (↓↓) excessive pressure; *O* indicates insufficient pressure.

A is a simple clamp. It will be seen that the stomach is unduly crushed at the joint end of the blades, while their free ends gape and exert no control at all.

B, the free ends are fixed by a clip. This is an improvement, but, as shown, bruising is still liable to occur at the joint end or slipping and bleeding at the centre.

C shows the equality of pressure given by clamp under description. Note how the spring at *X* has risen to accommodate the thick stomach. It adjusts itself equally well to thin intestine, always keeping the blades parallel. It may also be mentioned here that the screw is capable of much finer adjustment than is a ratchet, as in handled clamps.

As regards the texture of the gripping surface; rubber-covered or smooth, fluted metal blades tend to slip, and injurious pressure is necessary to prevent this. Coarse serrations hold well but inflict direct damage. The optimum is a finely but sharply roughened metal surface: this has been adopted (Fig. 3).

The two clamps are entirely independent, an advantage over the three-bladed types, in using which difficulty may be experienced in securing the second viscus, and under these circumstances a distorted hold is more liable to be taken. They are fixed together by slipping in the undercut slide and pressing the " patent fastener " home.

It is capable of very rapid manipulation, and is more easily applied than clamps with handles, especially in the absence of assistance. It begins to grip at the spring end. Here one end of the selected loop is secured, one hand controlling the free end of the blade while the other spreads out the loop as the blade closes on it. Most clamps close simultaneously at the joint and distal ends, and the single free hand is unable to spread out the loop satisfactorily. The blade, having been closed, is instantly fixed by the split nut.

It weighs somewhat less than 140 gm., while the approximate weight of the commoner patterns is about 250 gm.

The working surface of the blades is 14 cm. long, as compared with 12.5 cm. of a typical gastro-enterostomy clamp. The over-all length is 20 cm. as against 34 cm. This moderate size has been found very convenient in private practice, where a large sterilizer may not be available.

The blades are curved. The convexity of the curve is directed into the abdomen, should delivery of the viscera be difficult. When this can be easily accomplished the convexity is directed outwards, and holds up the selected portions conveniently for suture (Fig. 3).

When the clamps are joined the laterally projecting screws steady the instrument and prevent its rolling.

It is, perhaps, rather more delicate than the usual instruments. The screw and joints require very thorough drying and a little oil when laid aside. It has, however, stood the severe test of four years' constant use in hospital well, and any clamp should have the above-mentioned attention.

A limitation which it shares with most other gastro-enterostomy clamps is that it can only take a lateral hold, since both ends are closed. It can, however, be applied across the stomach in gastric resections, where the curvatures of that organ have been freed from their peritoneal attachments. Hence it is a somewhat specialized instrument, its sphere of action being gastro-enterostomy, entero-anastomosis, enterotomy, gastric resection, etc.

It is made entirely of steel, and all angles and projections are rounded off. It is silver plated, and the screws are gilt: this wears much longer than does nickel plating, and adds but little to the cost.

As regards its cost relative to that of other instruments of the same class; I am told that if it were made in similar numbers its price would be approximately the same. Being made specially, to single orders, it naturally costs considerably more.

Mr. J. W. Dowden, F.R.C.S.E., Surgeon to the Royal Infirmary, Edinburgh, has used the clamp for four years. I wish to express my gratitude to him for the interest he has taken in its production.

To Mr. S. Hurford I am much indebted for his intelligent coöperation in the manufacture. The instrument is obtainable from Messrs. Hurford & Drysdale, Surgical Instrument Makers, 15 Drummond Street, Edinburgh.

NORMAN M. DOTT, M.B., Ch.B.,
Edinburgh, Scotland.

THE RELATIVE PLACE OF PLASTER DRESSING AND OF SUSPENSION APPARATUS IN THE TREATMENT OF FRACTURES

EDITOR, ANNALS OF SURGERY:

In an article entitled "The Portable Suspension Frame Employed in the Treatment of the Wounded During the European War,"[1] by Dr. H.

[1] ANNALS OF SURGERY, June, 1920.

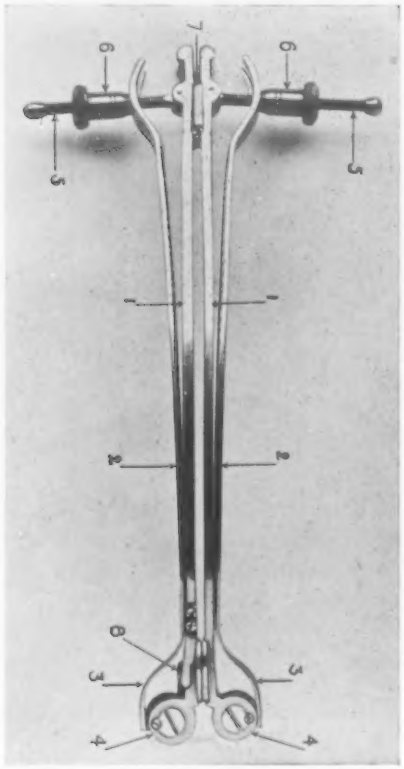


FIG. 1.—Clamp assembled.

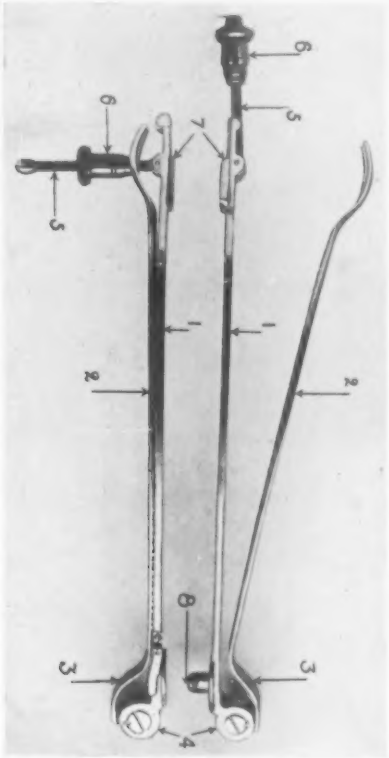


FIG. 2.—The two elements of the clamp separated, one open, one closed.

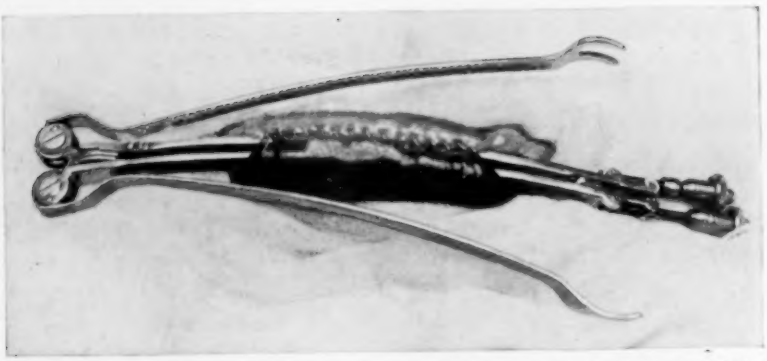


FIG. 3.—Anastomosis completed; set screws turned down to facilitate withdrawal of the clamp.

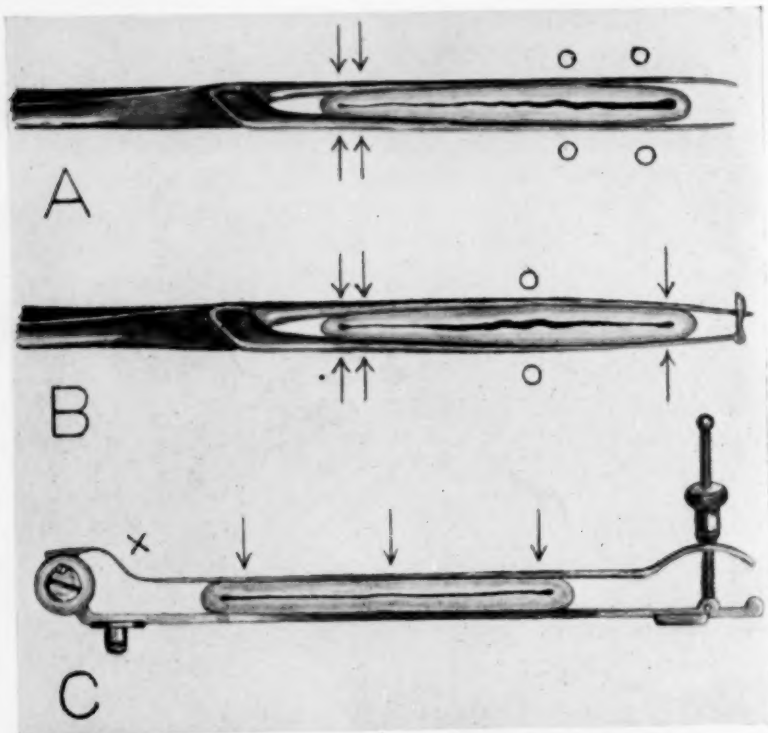


FIG. 4.—Showing the more equal impression exercised by the author's clamp as compared with the scissors action of the usual model of clamp.

H. M. Lyle, the author elaborates the description of his invention with a few remarks in connection with the treatment of fractures.

He says, "in the early period of the war the dominant note in the treatment of fractures was immobilization. The majority of cases were encased in plaster of Paris in which windows were cut, or metal arches made to give access to the wounds. The immediate results were filth, infection, and gangrene; the late results pressure sores, atrophied muscles, and ankylosed joints. So much for the so-called orthopædic treatment of fractures."

This statement is too sweeping to escape comment. What Doctor Lyle doubtless means is that the results he deplores were due to the attempt to treat compound fractures by plaster of Paris, a phrase which he condenses by the use of the shorter and uglier one, "orthopædic treatment." He then goes on to imply that the results of the treatment of fractures by plaster of Paris are "pressure sores, atrophied muscles, and ankylosed joints."

This implication is not well founded, as for years fractures have been treated with immobilization in plaster of Paris by surgeons in general as well as orthopædic surgeons with a fair degree of success. It is also inaccurate to confuse orthopædic treatment with the use of plaster of Paris. The results he criticises were those of the early days of the war, when all treatment was in a generally chaotic state. The atrophied muscles, pressure sores, and gangrene were the results of the infected wounds occurring in conjunction with the fractures, when surgeons were falling between the two stools of treating wounds and neglecting the fracture, or treating the fracture and neglecting the wounds. In the light of further experience the attempt to apply plaster of Paris in conjunction with open wounds and the possibility of extension of the suppurative process beneath the plaster appears, to say the least, ill advised. The statement may hardly be disputed that the development of the treatment of fractures by traction and suspension was due to the necessity of evolving a method of treatment which allowed primarily ready access to the wounds and the maximum comfort of the patient. The further application of traction for the treatment of fractures came next. Last of all was the general discovery that fractures so treated gave good functional results.

The enthusiastic advocacy of the treatment of all fractures by traction and suspension represents the furthest excursion of the pendulum from the pre-war practice of the almost universal use of plaster of Paris. The present extremists were forced to treat fractures as an incident in the treatment of wounds, and as a necessity in saving the lives of their patients. They were incidentally surprised to note the unexpectedly good functional and anatomic results which they obtained in the fractures. The treatment of fractures by traction and suspension is being very gen-

erally spoken of as one of the great lessons of the war, in spite of the fact that Bardenheuer had published a book upon the subject in 1907.[2]

No one will deny that the treatment is an excellent one in the hands of certain individuals. Its disadvantages are that it confines the patient to bed, that it requires very considerable mechanical ingenuity and skill on the part of its applicator, and that it is largely at the mercy of the patient and his attendants, who may easily disarrange one of its several essential features with consequent unhappy results.

No one will deny that plaster of Paris in the hands of certain individuals is also an excellent treatment. It can rarely be used in the presence of suppuration. The danger of swelling beneath the plaster is always present. If not properly applied no dressing is more uncomfortable, and no dressing offers the possibility of graver complications in unskilled hands.

The confusion of "orthopædic treatment" with the use of plaster of Paris is difficult to understand. The consulting orthopædic surgeon to the hospital with which Doctor Lyle is connected has been a life-long opponent of the use of plaster of Paris. Sir Robert Jones, an orthopædic surgeon of distinction, scarcely ever uses it, which explains the fact that it was practically never seen throughout the British Army. The distinction between orthopædic and general surgery lies in the fact that the former has as its constant purpose "to prevent or to correct deformity and to preserve or restore function, a purpose which governs treatment from the beginning and to the end."[3]

The treatment of fractures has unquestionably been greatly benefited by the war. It is now generally appreciated that they are difficult to treat; that they may be treated in a variety of ways; that they should be treated by surgeons familiar with these various methods and capable of weighing their advantages in relation to their application to a given case; and most important of all, is the great stress now being laid upon the factor of greatest importance to the patient, the ultimate functional result.

ARMITAGE WHITMAN, M.D.

---

[2] Die Allgemeine Lehre von der Frakturen und Luxationen. B. Bardenheuer, Stuttgart, 1907.

[3] Whitman, R.: Orthopædic Surgery. Lea & Febiger, Philadelphia, 6th Edition.

To Contributors and Subscribers:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS *of* SURGERY
227-231 S. 6th Street
Philadelphia, Penna.

INDEX TO VOLUME LXXII

INDEX TO ADVERTISERS

(*Continued on page 6*)

STELLITE

The master metal for surgical instruments

STELLITE is the only known metal possessing every quality that surgery demands in instruments.

Stellite is rustless. Moisture cannot affect it.

Stellite is untarnishable. Its silvery white lustre is permanent—never requires polishing.

Stellite is non-corrosive. It is proof against the chemicals used in sterilizing processes.

Stellite is the hardest known metal for edged tools and instruments. Its hardness is inherent—not tempered—therefore permanent.

Stellite surgical instruments take and hold a keener edge through longer periods of use and abuse than instruments of any other metal.

HAYNES STELLITE COMPANY

Kokomo, Indiana

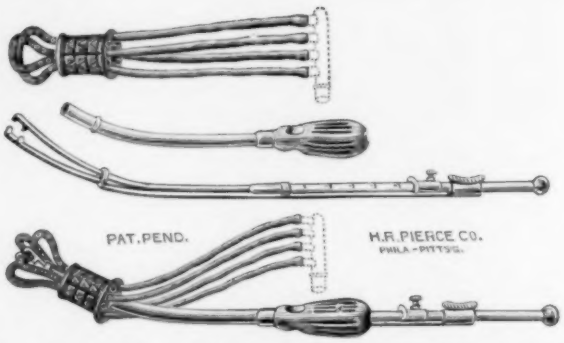
Carbide and Carbon Building, 30 East 42nd Street, New York

Peoples Gas Building, Chicago, Ill.

8-20-8-4

INDEX TO ADVERTISERS, CONTINUED FROM PAGE 4

DR. WM. O'NEILL SHERMAN'S UTERINE STERILIZATION PESSARIES



For the prophylactic or abortive treatment of puerperal fever or the early stages of uterine infection

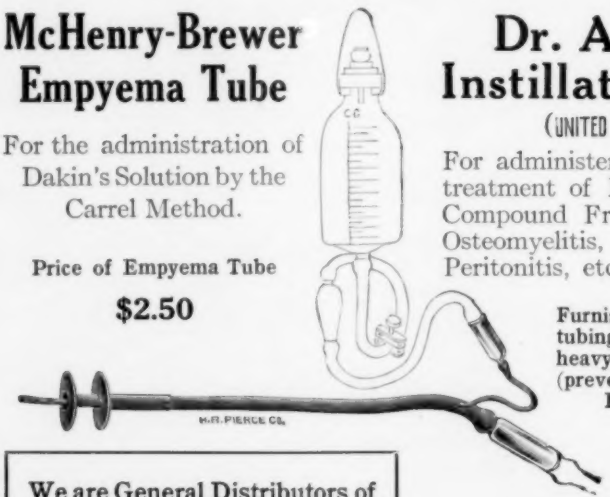
Set consisting of 4 hard rubber, self-retaining pessaries; 2 introducers and tube carrying forceps; graduated uterine sound, Simpson's; forked gauze packer; 2 Carrel instillation tubes with four outlets, two sizes; 14 feet instillation tubing, two sizes; punch forceps for perforating instillation tubing— **$35.00**

McHenry-Brewer Empyema Tube

For the administration of Dakin's Solution by the Carrel Method.

Price of Empyema Tube

$2.50



Dr. Alexis Carrel's Instillation Apparatus

(UNITED STATES ARMY STANDARD No. 320)

For administering Dakin's Solution in the treatment of Infected Wounds, Empyema, Compound Fractures, Acute and Chronic Osteomyelitis, Gangrenous Appendicitis, Peritonitis, etc.

Furnished with pure rubber tubing (free of sulphur) and heavy brown-glass reservoir (prevents disintegration of Dakin's Solution).

$4.50

We are General Distributors of

HYCLORITE

Concentrated Sodium Hypochlorite

Literature on application

MANUFACTURED BY

HARVEY R. PIERCE COMPANY

1801 Chestnut Street, PHILADELPHIA

The Modern Surgical Instrument Stores

PITTSBURGH SALES OFFICE, 3030, 3031, 3032, 3033 JENKINS ARCADE

Effective April 10th 1920 - Descriptive List No. 28 - Changeable Without Notice

DAVIS & GECK, INC.

PHYSIOLOGICAL CHEMISTS

KALMERID

Sterile Surgical Sutures

217-221 Duffield Street - Brooklyn, N. Y., U.S.A.

Claustro-Thermal Catgut

Boilable

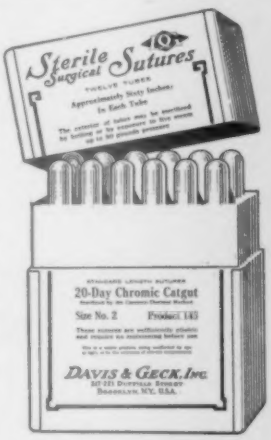
CLAUSTRO-THERMAL, meaning *enclosed heat*, is descriptive of the improved method of heat sterilization. The principle of the method consists in applying the heat after closure of the tubes, thus avoiding all the chances of accidental contamination.

The sealed tubes are submerged in a bath of cumol—the high boiling hydrocarbon. The temperature of the cumol bath is gradually elevated until at the end of six hours the maximum of 165° C. (329° F.) is reached. This temperature is maintained for five hours, and is then allowed to slowly decline. The temperature curve is graphically represented by the chart shown below.

It is obvious, therefore, that sterility is absolutely assured. The sutures, being stored in their original tubing fluid and reaching the surgeon's hands sealed within the tubes in which they were sterilized, are removed from all the chances of contamination incident to the customary method of sterilizing the strands in open tubes.

Sterilization by this integral method is made feasible through the use of toluol as the tubing fluid. The discovery of the value of toluol for this purpose was the outcome of an investigation aimed at finding a suitable fluid to replace chloroform. The latter was formerly in general use, but was unsatisfactory because it was found to break down into chemical products which not only exerted an extremely harmful action on the collagen of the sutures but which were responsible for considerable wound irritation.

No other mode of sterilization so completely fulfills the exacting requirements for the production of ideal sutures as does the Claustro-Thermal method. Through its use the natural physical characteristics of the strands are preserved, while the destruction of all bacterial life is absolutely assured.

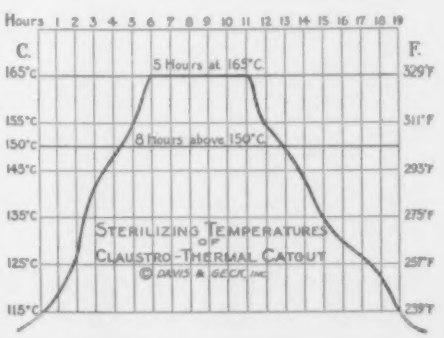


THE NEW PACKAGE
Containing One Dozen Tubes of a Kind and Size

Claustro-Thermal sutures are not impregnated with any germicidal substance, and consequently they exert no bactericidal influence in the tissues.

This product embodies all the essentials of the perfect suture, such as compatibility with tissues, accuracy of size, maximum tensile strength, perfect and dependable absorbability, and absolute sterility.

Reprints of original articles relating to the Claustro-Thermal method will be sent upon request.



List of Claustro-Thermal Catgut

Approximately Sixty Inches in Each Tube

Plain Catgut	Product No. 105
10-Day Chromic Catgut	Product No. 125
20-Day Chromic Catgut	Product No. 145
40-Day Chromic Catgut	Product No. 185

SIZES: 000...00...0...1...2...3...4

Claustro-Thermal sutures are unaffected by age, light, or extremes of climatic temperatures

Price in U. S. A.

Per dozen tubes (subject to a fixed discount on quantities) $3.60

Please specify clearly the PRODUCT NUMBERS and SIZES desired

CONTINUED—

Kalmerid Catgut

An Improved Germicidal Suture
Superseding Iodized Catgut

KALMERID CATGUT is not only sterile, but, being impregnated with potassium-mercuric-iodide—*a double iodine compound*—the sutures exert a local bactericidal action in the tissues.

The older practise of impregnating catgut with the ordinary crystalline iodine for this purpose was at best an unsatisfactory method, since the antiseptic power was but slight and transient. The most serious deficiencies of such iodized sutures, however, were their instability and weakness arising from exposure to light; the deterioration resulting from the continuous and unpreventable oxidizing action of the iodine; and the disintegration of the sutures when heated. Moreover, the decomposition products of iodine caused such sutures to be irritating.

These serious disadvantages of iodized catgut have been overcome through the use of potassium-mercuric-iodide instead of iodine. This double salt of iodine and mercury, the chemical formula of which is $HgI_2.2KI$, is one of the most active germicides known, exerting a killing action on bacteria about ten times greater than that of iodine. It does not break down under the influence of light or heat, it is chemically stable, and, in the proportions used, is neither toxic nor irritating to the tissues. It interferes in no way with the absorption of the sutures, and is not precipitated by the proteins of the body fluids.

Kalmerid catgut, in addition to its bactericidal attribute, embodies all the essentials of the perfect suture. It is perfectly compatible with the tissues, its absorbability is dependable, and its tensile strength is particularly good.

TWO VARIETIES—To meet the requirements of different surgeons two kinds of Kalmerid catgut are prepared—the boilable, and non-boilable.

BOILABLE GRADE—This variety is prepared for surgeons who prefer a boilable suture, such as the Claustro-Thermal product, but possessing bactericidal properties in addition. The boilable grade, therefore, besides being impregnated with potassium-mercuric-iodide, embodies the desirable physical characteristics of the Claustro-Thermal sutures. It has the same moderate degree of flexibility; it is the same in appearance; it is tubed in the same improved storing fluid—toluol; and, after impregnation with potassium-mercuric-iodide, it further receives the Claustro-Thermal sterilization—that is, heat sterilization after closure of the tubes.

NON-BOILABLE GRADE—This variety is extremely pliable as it comes from the tubes. It is made for those surgeons who have been accustomed to the flexibility of iodized catgut.

Reprints of original articles relating to Kalmerid sutures will be sent upon request.

List of Kalmerid Catgut

Approximately Sixty Inches in Each Tube

Boilable Grade		Non-Boilable Grade	
Plain Catgut	Product No. 1205	Plain Catgut	Product No. 1405
10-Day Chromic	Product No. 1225	10-Day Chromic	Product No. 1425
20-Day Chromic	Product No. 1245	20-Day Chromic	Product No. 1445
40-Day Chromic	Product No. 1285	40-Day Chromic	Product No. 1485

SIZES: 000...00...0...1...2...3...4

Please specify clearly the PRODUCT NUMBERS and SIZES desired

Kalmerid sutures are unaffected by age or light, or by the extremes of climatic temperatures

Price in U. S. A.

Per dozen tubes (subject to a fixed discount on quantities).....$3.60

In packages of twelve tubes of a kind and size as illustrated on first page

DAVIS & GECK, INC. 217-221 Duffield Street, Brooklyn, N.Y., U.S.A.

Kalmerid Kangaroo Tendons

Two Varieties—Boilable and Non-Boilable

THESE are the sutures *par excellence* for those procedures in which post-operative tension is excessive, or long continued apposition necessary, such as in herniotomy, and in tendon and bone suturing. Kalmerid kangaroo tendons are not only sterile, but, in addition, they are impregnated with potassium-mercuric-iodide, which enables them to exert a local bactericidal action in the tissues. The impregnating and sterilizing methods are the same as practised in the preparation of Kalmerid catgut, and described on the preceding page.

They are genuine kangaroo tendons; they are round, smooth, straight, of uniform contour, and possess a tensile strength about twice that of the best catgut of equivalent size.

Because of their greater strength some surgeons prefer these tendons to catgut, particularly in the finer sizes, for general intestinal, muscle, fascia, and skin suturing.

ABSORPTION TIME—The tendons are chromicized, and so accurately is the chromicizing process regulated that each size, whether it be the finest or the coarsest, will maintain apposition in fascia or in tendon for approximately thirty days. Shortly after that period the sutures, with their knots, will be completely absorbed.

TWO VARIETIES—Kalmerid kangaroo tendons are prepared in two grades—boilable and non-boilable.

The NON-BOILABLE tendons are extremely pliable and consequently require no moistening.

The BOILABLE tendons are quite stiff as they come from the tubes, but may be rendered pliable by moistening in sterile water preliminary to use. The smaller sizes will be sufficiently softened by fifteen minutes immersion, while the larger sizes should be immersed for about thirty minutes. Either sterile water, or an aqueous bactericidal solution made with Kalmerid tablets—1:5000—should be used.

Before immersion, the toluol, which is very volatile, should be allowed to evaporate so that the water may have access to the sutures.

Reprints of original articles relating to Kalmerid sutures will be sent upon request.

List of Kalmerid Kangaroo Tendons

Each Tube Contains One Tendon — Lengths Vary From 12 to 20 Inches

The Non-Boilable Grade is *Product No. 370*
Boilable Grade is *Product No. 380*

— Sizes —

Tendon Sizes:	Ex. Fine	Fine	Medium	Coarse	Ex. Coarse
Catgut Sizes:	0	2	4	6	8

Please specify clearly the PRODUCT NUMBERS and SIZES desired

Kalmerid kangaroo tendons are unaffected by age or light, or by the extremes of climatic temperatures

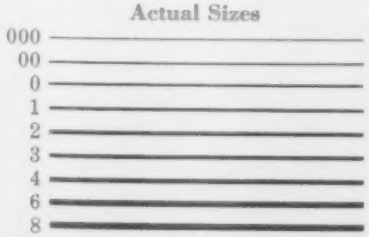
Price in U. S. A.

Per dozen tubes (subject to a fixed discount on quantities).....$3.60

In packages of twelve tubes of a kind and size as illustrated on first page

---

Actual Sizes



Standardized Sizes

The Established Metric System of Catgut Sizes is Now Used For All Sutures

IN conformity with the long recognized need for a unified system of sizes, the standard metric catgut scale has been extended to embrace all sutures, including kangaroo tendons, silk, horsehair, silkworm gut, and celluloid-linen thread.

The advantage of this standardized system is obvious.

Miscellaneous Sutures

Boilable

Sterilized by Heat After Closure of the Tubes

Product No.	Material	Approximate Quantity in Each Tube	Catgut Size
350	Celluloid-Linen Thread	60 Inches	000, 00, 0
360	Horsehair	Four 28-inch Sutures	00
390	Plain Silkworm Gut	Four 14-inch Sutures	00, 0, 1
400	Black Silkworm Gut	Four 14-inch Sutures	00, 0, 1
450	White Twisted Silk	60 Inches	000, 00, 0, 1, 2, 3
460	Black Twisted Silk	60 Inches	000, 0, 2
480	White Braided Silk	60 Inches	00, 0, 2, 4
490	Black Braided Silk	60 Inches	00, 1, 4
600	Catgut Circumcision Suture	30 Inches With Needle	00

Price in U. S. A.—Per dozen tubes (subject to a fixed discount on quantities) $3.60

In packages of twelve tubes of a kind and size as illustrated on first page

Minor Sutures

Short Length - Without Needles

Sterilized by Heat After Closure of the Tubes

Product No.	Material	Approximate Quantity in Each Tube	Catgut Sizes
802	Plain Catgut	20 Inches	00, 0, 1, 2, 3
812	10-Day Chromic Catgut	20 Inches	00, 0, 1, 2, 3
822	20-Day Chromic Catgut	20 Inches	00, 0, 1, 2, 3
862	Horsehair	Two 28-inch Sutures	00
872	Plain Silkworm Gut	Two 14-inch Sutures	0
882	White Twisted Silk	20 Inches	000, 0, 2
892	Umbilical Tape	Two 12-inch Ligatures	

Price in U. S. A.—Per dozen tubes (subject to a fixed discount on quantities) $1.80

In packages of twelve tubes of a kind and size as illustrated on first page

Emergency Sutures

With Needles

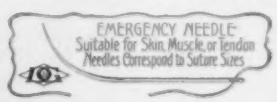
Sterilized by Heat After Closure of the Tubes

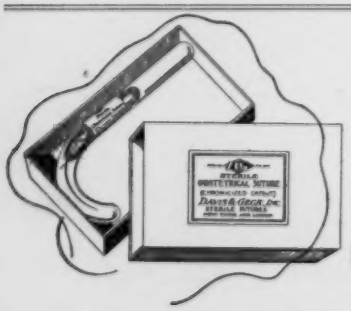
Product No.	Material	Approximate Quantity in Each Tube	Catgut Sizes
904	Plain Catgut	20 Inches	00, 0, 1, 2, 3
914	10-Day Chromic Catgut	20 Inches	00, 0, 1, 2, 3
924	20-Day Chromic Catgut	20 Inches	00, 0, 1, 2, 3
964	Horsehair	Two 28-inch Sutures	00
974	Plain Silkworm Gut	Two 14-inch Sutures	0
984	White Twisted Silk	20 Inches	000, 0, 2

Price in U. S. A.

Per dozen tubes (subject to a fixed discount on quantities) $3.60

In packages of twelve tubes of a kind and size as illustrated on first page





Obstetrical Sutures

Product No. 650

For the Immediate Repair of Perineal Lacerations

Each tube contains *two* 28-inch sutures of 40-day chromic catgut one of which is threaded upon a large full-curved needle

Price in U. S. A.

Per tube (subject to a fixed discount on quantities) ..... $ .35

Each tube in a package as illustrated

A HELPFUL DEPARTMENT FOR SURGEONS

THE AMERICAN INSTITUTE OF MEDICINE, through its Department of Surgery, aids the progressive surgeon by keeping him informed of new developments in his field. It also performs for him many special services that conserve his time and energy, and increase his professional efficiency.

An Expert Staff

is maintained by the Institute at its headquarters in New York. Fully experienced abstractors, translators, research workers, investigators, editors and consultants render the following services:

LITERATURE—Leading American and foreign journals read each month, and index and complete set of abstracts of all important articles relating to surgery, supplied.

RESEARCH—Investigations on surgical subjects made by trained research workers. Bibliographies compiled. Questions arising in surgical practice answered.

SPECIAL SERVICE—Special service given to meet the particular requirements of individual surgeons.

SURGICAL INFORMATION—Information furnished about important surgical developments, notices of meetings, and other matters of interest.

Conducted on Co-operative Plan

The Department of Surgery is conducted on a co-operative basis in the interest of the surgeon members of the Institute who use the department. Each member pays a moderate annual fee and in return receives the complete service provided by the staff.

Surgeons who are interested in learning more about the work done by this Department are invited to send in the inquiry coupon attached. Literature containing more detailed information and membership application blank will be forwarded. No obligation is created by this request.

American Institute of Medicine
13 East 47th Street
NEW YORK CITY

AMERICAN INSTITUTE OF MEDICINE
13 East 47th Street
New York City

Please send me more information about your Department of Surgery, and membership application blank.

Name.....

.....
(Please Print)

Street.....

Town.....

State.....

(Annals of S. 12-26)

Adrenalin in Medicine

3—Treatment of Shock and Collapse

THE therapeutic importance of Adrenalin in shock and collapse is suggested by their most obvious and constant phenomenon—a loss in blood pressure.

The cause and essential nature of shock and collapse have not been satisfactorily explained by any of the theories that have been advanced, but all observers are agreed that the most striking characteristic of these conditions is that the peripheral arteries and capillaries are depleted of blood and that the veins, especially those of the splanchnic region, are congested. All the other symptoms—the cardiac, respiratory and nervous manifestations—are secondary to this rude impairment of the circulation.

The term collapse usually designates a profound degree of shock induced by functional inhibition or depression of the vasomotor center resulting from some cause other than physical injury, such as cardiac or respiratory failure.

Treatment aims to raise the blood pressure by increasing peripheral resistance. As a rapidly acting medical agent for the certain accomplishment of this object Adrenalin is without a peer. In cases of ordinary shock it is best administered by intravenous infusion of high dilutions in saline solution. Five drops of the 1:1000 Adrenalin Chloride Solution to an ounce of normal salt solution dilutes the Adrenalin to approximately 1:100,000, which is the proper strength to employ intravenously. A slow, steady and continuous stream should be maintained by feeding the solution from a buret to which is attached a stop-cock for the regulation of the rate of flow.

In those cases marked by extremely profound and dangerous shock or collapse the intravenous method may prove too slow or ineffective. Recourse should then be had to the procedure described by Crile and called centripetal arterial transfusion. Briefly it consists in the insertion into an artery of a cannula directed *toward* the heart. Into the rubber tubing which is attached to the cannula 15 to 30 minims of Adrenalin 1:1000 is injected as soon as the saline infusion begins.

The effect of this is to bring the Adrenalin immediately into contact with the larger arteries and the heart. Sometimes, even in apparent death, the heart will resume its contractions, thereby distributing the Adrenalin through the arterial system and accomplishing the object of this heroic measure—resuscitation and elevation of the blood pressure.

PARKE, DAVIS & COMPANY

Announcement of Merging of Victor Electric Corporation with X-Ray Interests of General Electric Company

An arrangement has been completed which took effect October 1, 1920, under which the entire business of the Victor Electric Corporation and X-Ray interests of the General Electric Company have been merged in a new corporation formed for the purpose and known as the VICTOR X-RAY CORPORATION. The new company, has exchanged its capital stock for the X-Ray patents and good will of General Electric Company and for the assets and business of the old Victor Electric Corporation.

The formation of the new company will result in full manufacturing, engineering and research co-operation between Victor X-Ray Corporation and General Electric Company with respect to X-Ray problems. It will extend further the usefulness of the two companies and consequently, present needs for Coolidge tubes and other X-Ray devices will be adequately met.

The executive, administrative, engineering and sales staff of the old Victor Electric Corporation will remain practically unchanged. Mr. C. F. Samms becomes President and General Manager. Mr. J. B. Wantz retains full charge of manufacturing and designing. It is contemplated to bring about a complete co-ordination of the entire Victor Corporation organization with the research and engineering organization of General Electric Company with as little disturbance of the old relationships as possible.

Dr. W. D. Coolidge of the research laboratory of General Electric Company becomes Consulting Engineer of the Victor X-Ray Corporation. Mr. C. C. Darnell of the research laboratory of General Electric Company becomes the Commercial Engineer of the Victor X-Ray Corporation. Mr. W. S. Kendrick, who for many years had charge of the commercial sale of the Coolidge tube, will be General Sales Manager. Mr. L. B. Miller remains General Manager of Agency Sales.

The Victor X-Ray Corporation will continue to carry out the same liberal policies and practices toward the X-Ray trade that have already been established by the General Electric Company.

The primary purpose of this merger was to co-ordinate the efforts of the best and most constructive elements in the research, engineering and commercial divisions of the X-Ray field to the end that users of X-Ray equipment might be served in the best possible manner, and assurances are given by the officers of the new corporation that the ideal toward which they intend to strive is 100% service.

VICTOR X-RAY CORPORATION

C. F. Samms, *President*